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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

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SUBJECT: Southern Maryland Wood Treatment Site: Revised Focused Post-remedial Health Risk Assessment

FROM: Roy L. Smith, Ph.D., Senior Toxicologist
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TO: Lesley Brunker
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As requested, the revised draft health risk assessment for the nine remedial alternatives for on-site soils evaluated in the Focused Feasibility Study (FFS) is attached. The assessment includes descriptions of the procedures and assumptions under which risks were estimated, and a section that describes the various sources of uncertainty in the risk estimates.

It is important that the local citizens who read this report understand the following limitations of the risk assessment:

- *Scope of the risk assessment.* These risk estimates are an augmentation of EPA's Feasibility Study (FS) for cleaning soils at the site. They are not intended to replace the existing baseline risk assessment, but rather to focus on the greatest risks to the most exposed populations during and after remediation of the site. Accordingly, this risk assessment is independent of the baseline risk assessment, and neither accepts nor rejects any part of that document. EPA believes that updating the baseline risk assessment would serve no useful purpose, while significantly delaying decision-making for the site.

  Risks from contamination in soil and air during and after cleanup have been estimated for each of the remedial alternatives. In addition, at the request of the Environmental Awareness Coalition of Southern Maryland (a citizens' group concerned about the site), estimates of risk associated with groundwater use have been included for 5 remedial alternatives.

- *Exposed Populations.* The risk assessment was limited to potential future residents and future construction workers, because these populations were judged to have the highest potential exposure to surface and subsurface soil, respectively. Other potentially exposed populations such as hunters, trespassers, and non-construction workers would be expected to have lower exposures, and therefore less risk. These groups were omitted.

- *Exposure Routes.* The risk assessment considered inhalation of particulate and vapor released during remedial action, and incidental soil ingestion and vapor inhalation after remediation. As described above, five groundwater ingestion scenarios were also included. Dermal

uptake and particulate inhalation after remediation were judged to be unimportant for these contaminants, and were omitted.

- *Uncertainty in the Risk Assessment.* The document explicitly describes the sources of uncertainty, and EPA's protective treatment of this uncertainty. It is important that readers realize that EPA's numerical risk estimates are very conservative upper bounds that are highly likely to be overestimates of actual risk. These risk numbers should not be confused with best estimates. The true risks would probably be less, and may be zero.

- *Revisions since the last draft.* This version of the risk assessment incorporates the following revisions, made in response to your requests and comments by the Maryland Department of the Environment.

  1. Groundwater risks have been fully integrated into the risk assessment.

  2. The risk summary table has been split into two tables - one for cancer and one for non-cancer effects. The tables' format has also been changed.

  3. More information on the uncertainty associated with the air concentration estimates has been added.

  4. A sentence informing readers about risks from background PAH concentrations has been added.

  5. The concept of combining exposure parameters to achieve a "reasonable maximum exposure" estimate has been clarified.

  6. The reasons for not assessing risks due to commercial/industrial development of the site have been clarified.

  7. The source of the assumption that construction workers would ingest 480 mg of soil per day has been provided.

- *Comment not addressed by the revisions.* Because I have no treatability data extending to 563 days, I couldn't determine if the additional time would significantly change the regression slopes or predicted cleanup levels for Alternative 8.

Please let me know if I can provide further assistance with this site.

Attachment

cc: Eric Johnson (3HW13)
Kathy Davies (3HW13)
Dave Kargbo (3HW13)
Patricia Flores (3AT11)

FOCUSED HUMAN HEALTH RISK ASSESSMENT
RISKS AFTER REMEDIATION FOR NINE REMEDIAL ALTERNATIVES FOR THE SOUTHERN MARYLAND WOOD TREATMENT SITE

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November 17, 1994

1 Introduction

1.1 *Purpose of the Risk Assessment.*

This report contains EPA's quantitative estimate of the residual risks to human health associated with remediation by each of nine technologies evaluated by the Focused Feasibility Study for the Southern Maryland Wood Treatment NPL site. The scope of this report is limited to contamination in soil and potential transfer of soil contamination to air and groundwater. Potential health risks associated with transfers of contaminants from air to soil were beyond the scope of this focused assessment, and were not evaluated.

The report describes the assumptions under which the following were determined: (1) likely post-remedial soil concentrations, (2) potentially exposed human populations (both during and after cleanup), and (3) toxicity of the contaminants. Risks were calculated according to methods and assumptions recommended by EPA national guidance wherever possible, augmented as necessary by professional judgment.

2 Exposure Assessment

2.1 *Exposed populations.*

The exposure assessment concentrated on two populations which could potentially be exposed to site-related contaminants after the cleanup action: residents (both current and future, including small children) who presently live near the site and who could occupy new homes built on the site, and construction workers involved in building the new homes. Other populations such as trespassers, hunters and fishermen, or future commercial users of the site were not evaluated because their contact with site contaminants, and therefore their risks, would be lower.

2.2 *Selection of Contaminants of Concern.*

This risk assessment includes the contaminants identified in the original 1988 baseline risk assessment and Record of Decision for the Southern Maryland Wood Treatment site, plus four additional volatile aromatic hydrocarbons. These contaminants are

carcinogenic and non-carcinogenic polynuclear aromatic hydrocarbons, pentachlorophenol, benzene, ethylbenzene, toluene, and xylene.

2.3 *Exposure pathways and routes.*

Exposure to site-related contaminants could happen both during and after soil remediation. Exposures during remediation were assumed to be limited to inhalation of volatile compounds and particulates released during excavation and treatment of the soil. The site was assumed secure, preventing direct contact of contaminated soil by trespassers during cleanup operations. To ensure protective risk estimates, inhalation exposure was assumed to occur at the point of maximum concentration, usually the fence line of the site. Actual exposures to airborne contaminants would probably be substantially lower.

Exposures assessed after remediation included incidental ingestion of contaminated soil, inhalation of volatile contaminants, and ingestion of contaminated well water. Dermal uptake and inhalation of contaminated dust were not considered in the post-remedial risk calculations. Dermal uptake was omitted because these particular contaminants are not believed to cross the dermal barrier in significant amounts. Dust inhalation was omitted because the assumed residential area would likely be well-vegetated, limiting airborne dust emissions to small amounts. Therefore, both dermal uptake and particulate inhalation doses would be expected to be trivial relative to direct ingestion and inhalation of volatiles.

2.4 *Quantification of exposure.*

Exposure scenarios were selected to reflect reasonable maximum exposures, as recommended by EPA's *Risk Assessment Guidance for Superfund.* Pertinent details of the post-remedial concentrations and exposure scenarios are summarized below:

2.4.1 *Chemical concentrations in soil.*

Soil concentrations projected to remain after each of the proposed remedial alternatives are summarized in Table 49. These estimates were developed by reasonable extrapolations from current conditions, from experience with other sites, from decay curves measured by the EPA Emergency Response Team (ERT) in the 1994 Treatability Study for the site, and by best judgment, as follows:

Alternative 1: No Action. The property was assumed to be developed for residential use. Contaminant concentrations in soils of some residences, located in the most contaminated parts of the site, would be similar to levels measured in soils at the beginning of the ERT treatability study (Table 2). Workers building the homes would be exposed to the same contaminant concentrations as residents. The ERT concentrations were used instead of data from the original Remedial Investigation for the site because (1) the ERT data were more recent, and are therefore more likely to represent current site conditions, (2) the ERT data were

obtained from sampling numerous large amounts of homogenized soil, and are therefore likely to represent actual average contaminant levels over a large part of the site, and (3) as initial levels in soils later remediated in ERT's pilot study, the ERT data were considered most representative of the no action alternative.

Alternative 2: Limited Action. Enhanced security was assumed to end, allowing the site to be developed for residential use. Exposure concentrations would be identical to Alternative 1.

Alternative 3: Capping and Containment. The entire site was assumed to be capped and institutional controls put in place, preventing all development. Soil concentrations at the exposure point would be typical of uncontaminated areas, so excess contaminant concentrations were assumed to be zero. Because PAHs are ubiquitous contaminants in urban and suburban areas, contact with soils containing background PAH levels do present a small health risk, typically on the order of 1 in 1 million.

Alternative 4: Excavation, Capping and Containment. Under the same assumptions as Alternative 3, the excess post-remedial soil exposure concentrations would be zero. *(It is important to realize that the analysis of post-remedial risk associated with the capping alternatives are valid only if the cap remains intact. Therefore, the decision criterion for long-term effectiveness and permanence is a primary factor in evaluating the capping alternatives.)*

Alternative 5: Excavation and Offsite Disposal. Surface soils containing more than 1 mg/kg and subsurface soils exceeding 10 mg/kg of carcinogenic PAHs were assumed to be removed from the site. The site would be graded and covered with clean topsoil having background PAH concentrations, and subsequently developed for residential use. Excess surface soil concentrations would be zero; subsurface soil CPAH concentrations would be 10 mg/kg, apportioned among contaminants (Table 3).

Alternative 6: Thermal Treatment. Surface soils containing more than 1 mg/kg and subsurface soils exceeding 10 mg/kg of carcinogenic PAHs were assumed to be excavated and incinerated. After incineration, the site would be graded, and the ash amended with topsoil and spread across the site. The average concentration of CPAHs in surface and subsurface soils would be 1 and 10 mg/kg, respectively, apportioned among contaminants, as for the excavation scenario (Table 3).

Alternative 7: Thermal Desorption. The assumptions involving soil excavation, remediation, and post-remedial conditions were the same as for Alternative 6.

Alternative 8: Excavation/Onsite Solid Phase Bioremediation. Soils containing more than 1 mg/kg and subsurface soils exceeding 10 mg/kg of carcinogenic PAHs were assumed to be excavated and composted. Contaminants would degrade according to logarithmic regressions described in Appendix H of the EPA Emergency Re-

sponse Team's creosote/PCP treatability study. Composting would continue for either 5 or 10 years. Concentrations of all carcinogenic PAHs were assumed to decay according to the regression for benz[a]anthracene, the only CPAH for which a significant decay rate was found in the 300-day treatability test.

Considerable uncertainty exists in these estimates because results from a 300-day study were extrapolated to predict performance over much longer periods. It is possible that PAH decay may slow as concentrations decrease, or that some CPAHs may not degrade as quickly as benz[a]anthracene. Evidence from other sites also suggests that CPAH degradation rates may increase with time as the oily creosote matrix breaks up, exposing more surface area to the bacteria. Results of the bioremediation calculations are shown in Table 4.

Alternative 9: Excavation/Onsite Slurry Phase Bioremediation. Soils containing more than 1 mg/kg and subsurface soils exceeding 10 mg/kg of carcinogenic PAHs were assumed to be excavated, washed, and treated by activated sludge bio-oxidation. After treatment, coarse and fine materials would be re-combined and replaced on the site. Each PAH was assumed to be present in this composite material at 5% of its original soil concentration (as recommended by Dr. Harry Allen, pers. comm., 9/27/94). Treatment was estimated to continue for 12 years, and possibly longer depending on feasible dilution rates and tank sizes. Both surface and subsurface soils were assumed to contain the same concentrations (Table 5).

2.4.2 *Chemical concentrations in air.*

At the request of the EPA Region 3 Remedial Project Manager, contaminant concentrations in air were estimated by Patricia Flores of the Region 3 Air, Toxics, and Radiation Division. Her report is attached, in Appendix 1. The report includes all evaluated remedial alternatives, with separate estimates for releases during and after remedial operations. Air releases during excavation and staging of the bioremediation operation were assumed to be the same as those for incineration.

2.4.3 *Chemical concentrations in groundwater.*

At the request of the Environmental Awareness Coalition of Southern Maryland, a local citizens' group, Dr. David Kargbo of the Region 3 Hazardous Waste Management Division used a mathematical model to estimate subsurface soil concentrations for each site contaminant which would be protective of groundwater quality in the nearest monitoring well. EPA is distributing Dr. Kargbo's report separately. To develop inputs to the risk assessment, Dr. Kargbo calculated steady state groundwater quality at a point just outside the current sheet piling, at the soil concentrations projected to remain after remediation by alternatives 6, 7, 8, and 9. These concentration estimates are presented in Appendix 2.

2.4.4 *Exposure Scenarios and Assumptions.*

EPA's Risk Assessment Guidance for Superfund provided the exposure assessment algorithms. Site-specific assumptions were used for the amount of time each remedial alternative would be expected to require. National default assumptions were used for all other exposure factors (e.g., ingestion rate, duration and frequency of exposure, body weight, etc.). Construction workers were assumed to have "intensive" soil contact, so the national default ingestion rate of 480 mg/d was selected. Algorithms and assumptions used to estimate contaminant dose, in milligrams of contaminant per kilogram of body weight per day (mg/kg/d), are shown in Tables 6 through 48.

The national default exposure assumptions used in this risk assessment were selected to estimate reasonable maximum exposure when combined. "Reasonable maximum" means the highest exposure which a normal individual would be likely to receive, approximately 90th or 95th percentile. Actual exposures for most receptors would be expected to be less. Of particular note are the assumptions on which groundwater exposure was based. Receptors were assumed to ingest 2 liters of water per day, for 30 years, from a hypothetical well near the current sheet piling wall on the site. This exposure scenario was incorporated into the risk assessment at the request of concerned citizens living near the site, but EPA considers it unlikely.

3 Toxicity Assessment

For cancer-causing substances, EPA bases risk estimates on a contaminant's carcinogenic potency slope (CPS), defined as the upper bound probability of an individual contracting cancer from a daily dose of 1 milligram of the substance per kilogram of body mass per day. It is important to realize that the CPS is an upper bound, rather than best, estimate. The true risk will probably be less, and may be zero.

Substances which are not believed to cause cancer are assessed as systemic toxicants having threshold doses below which toxic effects do not occur. For these substances, EPA determines a reference dose (RfD), defined as a daily intake rate in milligrams per kilogram of body mass, with uncertainty spanning perhaps an order of magnitude, that is not expected to cause adverse health effects in human populations, including sensitive individuals. The protectiveness of RfDs is similar to that of CPSs. Rather than a threshold for toxic effects, the RfD should be considered a daily dose which is highly likely to be safe.

Work groups of EPA scientists have developed CPSs and RfDs for approximately 600 substances. EPA makes these values available to the public through two major databases, the Integrated Risk Information System (IRIS), and the Health Effects Assessment Summary Tables (HEAST). CPSs and RfDs for the contaminants of concern at the Southern Maryland Wood Treatment site were assembled from these and other sources, and are presented in Table 1.

4 Risk Characterization

4.1 *Introduction.*

The results of the health risk calculations are presented in Tables 6 through 48; Tables 50 and 51 contain a summaries of the calculations. The lifetime cancer risk represents the upper bound of the excess probability that an exposed person could contract cancer as a result of the exposure. Numbers appear in scientific notation. For example, "1E-06" is read as "one times ten to the minus sixth power", or one chance in 1 million. The larger the number, the higher the risk: 1E-04, or one times ten to the minus fourth power (minus 4 being a larger number than minus 6), represents one chance in ten thousand of cancer, a risk 100 times higher than 1E-06. Because they are based on protective CPSs and reasonable maximum exposure estimates, EPA's cancer risk estimates should be thought of as upper bounds. Actual risk is likely to be less, and may be zero.

The systemic hazard quotient is a ratio between the estimated reasonable maximum exposure to a contaminant and its reference dose, a daily intake rate that EPA believes is safe for human populations. A hazard quotient greater then one means that the safe exposure level would be exceeded under conditions of reasonable maximum exposure. Because RfDs are set well below known thresholds and dose estimates are reasonable maxima, hazard quotients slightly greater than 1 are unlikely to produce adverse health effects.

The National Contingencies Plan (NCP) requires that EPA take action in most cases where estimated upper bound excess lifetime cancer risks exceed 1E-04 (1 in 10,000) or the sum of the individual hazard quotients for non-cancer effects exceeds 1. Additionally, the NCP allows EPA to consider action, depending on site-specific factors, where cancer risks are in the range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000).

The following sections discuss the risk results, for each remedial alternative. Risk estimates are summarized in Tables 50 and 51.

4.2 *Alternatives 1 and 2: No action or limited action.*

Total lifetime cancer risk to future residents would be 7E-04, mostly from incidental soil ingestion. The hazard quotient for a resident small child would be marginally above 1, suggesting a slight potential systemic hazard. Lifetime cancer risk and hazard quotient for future construction workers would be 3E-05 and 0.46, respectively, indicating some potential for cancer but not for systemic effects.

4.3 *Alternative 3: Capping and containment.*

Total lifetime cancer risk to future off-site residents would be 1E-07, associated with inhalation of volatile compounds from beneath the cap. The hazard quotient for a resident small child would be 0.15, suggesting no systemic hazard. Cancer and sys-

temic risks to future construction workers would be zero, because institutional controls would prevent development of the capped site.

4.4 *Alternative 4: Excavation, capping, and containment.*

Total cancer risk and hazard index due to remediation would be 7E-07 and 0.045, respectively, due to inhalation of dust and fumes released during excavation. Post-remedial risks to future off-site residents would be negligible, because volatile compounds would be lost during excavation and would not be present beneath the cap in significant amounts. Cancer and systemic risks to future construction workers would be zero, because institutional controls would prevent development of the capped site.

4.5 *Alternative 5: Excavation and off-site disposal.*

Total cancer risk and hazard index associated with remediation would be 2E-07 and 0.043, respectively, due to inhalation of dust and fumes released during excavation and hauling of contaminated soil. Because the excavated areas would be covered with clean soil (as in remedial alternative 4), direct contact with residual traces of contaminants would be eliminated. Also, air emissions from buried waste would not occur, because the soil would have been hauled elsewhere. Therefore, post-remedial risks to future residents would be zero. Because traces of contamination would remain in subsurface soil, cancer risk and hazard index for construction workers would 4E-07 and 0.0062, respectively.

It is also important to note that the contaminated soil would have to be hauled and treated *somewhere*, where it could pose potential health risks to other populations which were not considered in this assessment.

4.6 *Alternative 6: Thermal treatment.*

Total cancer risk and hazard index associated with remediation would be 9E-05 and 2.43, respectively, due almost entirely to groundwater ingestion. Cancer risk and hazard index for air releases during excavation, hauling, and incineration would be 2E-07 and 0.043; cancer risk and hazard index for post-remedial contact with contaminated soil would be 1E-06 and 0.0017. Cancer risk to construction workers would be 4E-07 and systemic hazard index would be 0.006, suggesting little potential for adverse health impacts.

4.7 *Alternative 7: Thermal desorption.*

Total cancer risk and hazard index associated with remediation would be 9E-05 and 2.43, respectively, due almost entirely to groundwater ingestion. Cancer risk and hazard index for air releases during excavation, hauling, and incineration would be 2E-06 and 0.043; cancer risk and hazard index for post-remedial residential contact with contaminated soil would be 1E-06 and 0.0017. Cancer risk to construction workers

would be 4E-07 and systemic hazard index would be 0.006, suggesting little potential for adverse health impacts.

The main difference between Alternatives 6 and 7 was in the risks associated with the treatment process itself. It is important to note that air release estimates for Alternative 7 were based on stringent screening-level assumptions about emissions from the thermal desorber, whereas releases for Alternative 6 were based on a detailed exposure assessment already performed by EPA. Therefore, the apparent difference in risk between these remedial alternatives may be exaggerated.

4.8 *Alternative 8: On-site bioremediation.*

Releases due to excavation and composting operations were assumed to be the same regardless of the total length of time, based on the assumption that longer periods of emissions would be offset by a lower intensity of activity on the site. Total cancer risk and hazard index associated with air releases during remediation would be 1E-05 and 0.043, respectively, due to inhalation of dust and fumes released during excavation, hauling, and composting of contaminated soil. Most of this total comes from the treatment process itself.

After 5 years of composting, post-remedial cancer risk due to soil ingestion by future residents would be 9E-05; the hazard index for a resident child would be 0.05. Cancer risk from groundwater ingestion would be 1E-04, with a systemic hazard index of 0.09. If composting continued for 10 years (assuming the degradation rate did not change) soil-related risk to future residents would be 1E-05; the hazard index for a resident child would be 0.007. Cancer risk and systemic hazard index from groundwater ingestion would be 1E-05 and 0.01, respectively.

For 5 years of composting, cancer risk to construction workers would be 4E-06 and systemic hazard index would be 0.02; for 10 years, the corresponding values would be 5E-07 and 0.002.

Calculations were not performed for 15 years of composting because the extreme extrapolations involved were judged too unreliable to produce meaningful results. However, if these calculations were performed, both risk and hazard index would be reduced another 87% over those at 10 years.

4.9 *Alternative 9: Excavation/Onsite Slurry Phase Bioremediation.*

Emissions and risks during remediation by alternative 9 due to excavation, materials handling, and bio-oxidation were assumed to be similar to those for remedial alternative 8. Total cancer risk and hazard index associated with air releases during remediation would be 4E-07 and 0.043, respectively, due to inhalation of dust and fumes released during excavation, hauling, and composting of contaminated soil. Most of this total comes from the excavation and hauling processes.

Post-remedial cancer risk due to soil ingestion by future residents would be 4E-05; the hazard index for a resident child would be 0.06. Cancer risk from groundwater ingestion would be 3E-04, with a systemic hazard index of 8.7. Cancer risk to construction workers would be 2E-06; systemic hazard index would be 0.02.

4.10 *Summary of risk estimates.*

Risks to potential future residents on or near the site were substantially higher than risks to construction workers. Both cancer risk and non-cancer hazard index for the no action alternative exceeded EPA's action criteria under the National Contingencies Plan. The hazard index for each other remedial alternative was below 1, EPA's threshold for concern.

Cancer risks associated with the capping and the off-site disposal alternatives were less than 1E-06, mainly due to the assumption that populations would have not direct contact with contaminated soil after remediation. Obviously, cap integrity would be a crucial concern in determining whether capping should be selected for this site.

Excluding groundwater exposure, cancer risks for the incineration and thermal desorption alternatives fell between 1E-06 and 1E-05, and cancer risks for the bioremediation alternatives were between 1E-05 and 1E-04. The 5-year bioremediation post-remedial risk was near EPA's 1E-04 ceiling for acceptable cleanups. The 10-year bioremediation risk, 1E-05, was approximately 9 times lower. The bio-slurry alternative, assuming 95% removal efficiency, was about mid-way between at 4E-05.

Cancer risks associated with groundwater ingestion exceeded EPA's 1E-04 ceiling for 2 remedial alternatives, 5-year composting and bio-slurry. Groundwater risks associated with incineration, thermal desorption, and 10-year composting fell between 1E-05 and 1E-04.

5 Uncertainty Analysis

5.1 *Dose-response assessment.*

5.1.1 *Carcinogenic potency slope factors.*

EPA's procedures for reducing the toxicological literature to potency slopes were intentionally designed to be protective in several ways.

First, carcinogenic slope factors were based on the linearized multistage model for carcinogenesis, which EPA has selected as the most protective model by which to extrapolate from high to low doses. There is no firm evidence that this model either is, or is not, appropriate for the particular carcinogens at the site. Use of a different model would produce lower lifetime cancer risk estimates.

Second, slope factors incorporate protective extrapolations from test animals to humans, based on relative surface area as a surrogate for metabolic rate. Some other federal agencies convert animal data to human equivalence using body mass, which is less protective. Use of body mass extrapolation would produce lower cancer risks estimates.

Third, slope factors are 95% upper confidence limits rather than best estimates. The true slope factors may be less, but are unlikely to be greater.

5.1.2 *Reference doses for non-carcinogens.*

The reference dose is defined as a daily intake of a contaminant, with uncertainty spanning perhaps an order or magnitude, believed unlikely to produce adverse effects in human populations, including sensitive individuals. Reference doses for some substances are based on limited data, and are probably well below the actual threshold for adverse effects, for two reasons.

First, in developing reference doses, EPA selects the most sensitive species and the adverse effect to that species which occurs at the lowest dose. In the absence of positive evidence to the contrary, EPA assumes that average humans may be ten times as sensitive as that species, and that sensitive humans may be ten times more sensitive than average humans. These assumptions, designed to give the benefit of uncertainty to the exposed public, may overestimate true risk for some contaminants.

Second, EPA bases the reference dose on the no observed adverse effect level (NOAEL) in animal studies whenever possible. The NOAEL is the highest dose at which test animals did not exhibit adverse effects relative to controls. Because most toxicological studies are designed with considerable gaps between test doses, the true threshold for adverse effects may be substantially higher than the NOAEL. Use of the NOAEL instead of the true threshold for effects provides an additional level of protectiveness in reference doses.

5.2 *Exposure assessment.*

5.2.1 *Exposure scenarios.*

The exposure assessment for the Southern Maryland Wood Treatment Site was based in part on assumptions that future residential development would not occur if the site were capped, but otherwise probably would occur. If the site were used for some other purpose, the exposure estimates for some remedial alternatives would probably be too high.

The exposure assessment also incorporates protective assumptions about the behavior of future residents and construction workers at the site. Persons who vary significantly from the assumed soil ingestion rates or time spent at the site would have cor

respondingly different exposures and risks. The groundwater risk estimates depend on residents' long-term use of a well in close proximity to buried waste.

5.2.2 *Exposure concentrations.*

Soil concentrations for the no-action and limited action alternatives were 95% upper confidence limits rather than averages. Concentrations associated with the other remedial alternatives were estimated by extrapolating treatability study data or thermal destruction performance from other sites, or by making reasonable assumptions about post-remedial site conditions, as described in the assessment.

Because of the limited data available for the remedial alternatives, air concentrations were estimated under stringent screening procedures, which assumed high levels of airborne particulate. Actual inhalation risks would probably be less, but are unlikely to be greater. Also, risks were based on concentrations at the most contaminated exposure point, usually the fenceline. It is highly unlikely that anyone would have a long-term exposure so close to the site.

Risks from groundwater ingestion were based on a model of contaminant transport via groundwater. The model required inputs of site-specific parameters such as soil type, porosity, grain size, etc. To the extent that these data were available, they were used. Best judgment was used to provide conservative estimates of unavailable inputs. The resulting modeled groundwater estimates may therefore be higher than actual concentrations. Also, risks were based on concentrations at the most contaminated exposure point, a hypothetical well 10 meters from the existing sheet piling wall. It is not likely that anyone would install a private well so close to the waste. If such a well were installed, the water would probably be unpalatable.

To the extent that these data, extrapolations, and assumptions about exposure to soil, air, and groundwater fail to adequately represent actual site conditions, the risk estimates will be biased.

5.3 *Summary of uncertainty.*

Wherever possible, uncertainty has been handled in ways that tend to overestimate exposure and risk. EPA recommends this practice in recognition of the significant uncertainties in the risk estimates, to avoid underestimating risks. Nevertheless, despite the protective procedures used, gaps in data on chemical concentrations, human behavior patterns, and potential future uses of the site may have caused risk to be underestimated. Overall, EPA believes that the actual health risks posed by the remedial alternatives would probably be less, and unlikely to be greater, than the estimated risk levels.

TABLES

Southern Maryland Wood Treatment Site

Reference doses and carcinogenic potency slope factors.

Sources:

i = EPA Integrated Risk Information System (IRIS)
h = EPA Health Effects Assessment Summary Tables (HEAST)
e = Interim value recommended by EPA ORD ECAO-Cincinnati
w = Withdrawn from IRIS or HEAST
* = Oral RfD or CPS substituted for unavailable inhaled value.

Contaminant	Oral RfD mg/kg/d	Inhaled RfD mg/kg/d	Oral Slope Factor kg·d/mg	Inhaled Slope Factor * kg·d/mg
Carcinogenic PAHs:				
Benzo[a]pyrene			7.30E+00 *i*	6.10E+00 *h*
Benzo[b]fluoranthene			7.30E-01 *e*	6.10E-01 *e*
Benzo[k]fluoranthene			7.30E-02 *e*	6.10E-02 *e*
Benz[a]anthracene			7.30E-01 *e*	6.10E-01 *e*
Carbazole			2.00E-02 *i*	2.00E-02 *
Chrysene			7.30E-03 *e*	6.10E-03 *e*
Noncarcinogenic PAHs:				
Acenaphthene	6.00E-02 *i*	6.00E-02 *		
Anthracene	3.00E-01 *i*	3.00E-01 *		
Fluoranthene	4.00E-02 *i*	4.00E-02 *		
Fluorene	4.00E-02 *i*	4.00E-02 *		
Naphthalene	4.00E-02 *w*	4.00E-02 *		
Phenanthrene	4.00E-02 *w*	4.00E-02 *		
Pyrene	3.00E-02 *i*	3.00E-02 *		
Pentachlorophenol	3.00E-02 *i*		1.20E-01 *i*	1.20E-01 *
Volatile aromatics:				
Benzene		1.71E-03 *e*	2.90E-02 *i*	2.90E-02 *i*
Ethylbenzene	1.00E-01 *i*	2.86E-01 *i*		
Styrene	2.00E-01 *i*	2.86E-01 *i*		
Xylene	2.00E+00 *i*	2.00E-01 *w*		

Table 2

11/17/94

Southern Maryland Wood Treatment Site

Existing conditions

Source: Appendix F, Results of Creosote/PCP Treatability Study, 2/4/94.

Basis:

1. Initial contaminant concentrations measured by the treatability study were assumed representative of current site conditions.

2. Observed CVs were less than 1, suggesting data were normally distributed.

Therefore, normal 95%UCLs were considered more representative of reasonable maximum exposures.

	Concentrations in mg/kg											
Contaminant	*Compost Pile 1*	*Compost Pile 2*	*Compost Pile 3*	*Compost Pile 4*	*Land Treatment Cell 1*	*Land Treatment Cell 2*	*Land Treatment Cell 3*	*Land Treatment Cell 4*	*Land Treatment Cell 5*	*Land Treatment Cell 6*	*Mean*	*95% UCL (normal)*
Carcinogenic PAHs:												
Benzo[a]pyrene	55	66	57	47	5	10	4	39	9	9	30.10	44.56
Benzo[b]fluoranthene	68	81	61	53	6	11	5	41	10	10	34.60	51.67
Benzo[k]fluoranthene	68	83	65	55	6	12	6	45	10	10	36.00	53.54
Benz[a]anthracene	140	170	120	88	14	25	12	93	24	22	70.80	104.92
Carbazole	520	640	340	150	41	78	110	180	79	83	222.10	342.80
Chrysene	230	230	170	130	17	31	15	110	28	28	98.90	149.63
Total CPAH:	1081	1270	813	523	89	167	152	508	160	162	492.5	747.12
Noncarcinogenic PAHs:												
Acenaphthene	650	780	510	310	73	140	66	480	120	120	324.90	477.04
Anthracene	1900	2400	1300	810	120	240	280	960	260	250	852.00	1311.64
Fluoranthene	880	1100	800	560	80	160	74	520	150	140	446.40	666.30
Fluorene	620	750	420	220	67	130	79	470	120	120	299.60	443.08
Naphthalene	680	710	390	140	110	200	130	830	160	180	353.00	515.58
Phenanthrene	1600	1900	1000	510	190	340	210	1300	310	320	768.00	1135.42
Pyrene	590	710	550	390	54	100	48	340	98	92	297.20	443.38
Total PAH:	8001	9620	5783	3463	783	1477	1039	5408	1378	1384	3833.6	5739.56
Pentachlorophenol	79	58	76	53	8	18	8	66	17	13	39.60	56.64
Volatile aromatics:												
Benzene												0.03
Ethylbenzene												3.40
Styrene												1.90
Xylene												5.90

Southern Maryland Wood Treatment Site

Estimates of contaminant levels remaining after removal
Initial concentrations: normal 95% UCLs from Table 1.

Basis:
1. *All contaminants were assumed to be equally affected by removal.*
2. *Apportionment by mass was assumed to be the same before and after removal.*
3. *The total mass of carcinogenic PAH in surface soil was assumed to be 1 mg/kg after removal.*
4. *Carcinogenic PAH in subsurface soil was assumed to be 10 mg/kg after removal.*

Contaminant	Initial Soil Conc. mg/kg	Postremedial Surface Soil Conc. mg/kg	Postremedial Subsurface Soil Conc. mg/kg
Carcinogenic PAHs:			
Benzo[a]pyrene	44.56	0.06	0.60
Benzo[b]fluoranthene	51.67	0.07	0.69
Benzo[k]fluoranthene	53.54	0.07	0.72
Benz[a]anthracene	104.92	0.14	1.40
Carbazole	342.80	0.46	4.59
Chrysene	149.63	0.20	2.00
Total CPAH:	747.12	1.00	10.00
Noncarcinogenic PAHs:			
Acenaphthene	477.04	0.64	6.38
Anthracene	1311.64	1.76	17.56
Fluoranthene	666.30	0.89	8.92
Fluorene	443.08	0.59	5.93
Naphthalene	515.58	0.69	6.90
Phenanthrene	1135.42	1.52	15.20
Pyrene	443.38	0.59	5.93
Total PAH:	5739.56	7.68	76.82
Pentachlorophenol	56.64	0.08	0.76
Volatile aromatics:			
Benzene	0.03	0.00	0.00
Ethylbenzene	3.40	0.00	0.00
Styrene	1.90	0.00	0.00
Xylene	5.90	0.00	0.00

Southern Maryland Wood Treatment Site

Estimates of concentrations remaining after composting.
Source: Statistical Analysis of Regression Results, Creosote/PCP Treatability Study, 2/4/94.

Basis:
1. *PAH having no significant regression slope were assigned the slope for benz[a]anthracene.*
2. *Contaminants degrade at a constant rate during 5 years of composting.*
3. *Only significant regression slopes were averaged, possibly overestimating actual performance.*
4. *PCP half life in soil was 178 days (Allen, pers. comm.)*

Contaminant	Initial Soil Conc. mg/kg	Log Initial Soil Conc. mg/kg	Mean Regression Slope	1 y Log Final Soil Conc. mg/kg	1y Final Soil Conc. mg/kg	5y Log Final Soil Conc. mg/kg	5y Final Soil Conc. mg/kg	10y Log Final Soil Conc. mg/kg	10y Final Soil Conc. mg/kg
Carcinogenic PAHs:									
Benzo[a]pyrene	44.58	1.6490	-0.000490	1.4701	29.52	0.7547	5.6848752	-0.1395	0.7252219
Benzo[b]fluoranthene	51.67	1.7132	-0.000490	1.5344	34.23	0.8190	6.5917297	-0.0753	0.8409096
Benzo[k]fluoranthene	53.54	1.7267	-0.000490	1.5499	35.47	0.8345	6.8305359	-0.0598	0.8713744
Benz[a]anthracene	104.92	2.0209	-0.000490	1.8420	69.51	1.1266	13.3852	0.2324	1.7075557
Carbazole	342.80	2.5350	-0.001153	2.1141	130.04	0.4302	2.6927852	-1.6746	0.0211526
Chrysene	149.63	2.1750	-0.000490	1.9962	99.12	1.2806	19.088114	0.3885	2.4350788
Total CPAH:	747.12				397.88		54.27		6.80
Noncarcinogenic PAHs:									
Acenaphthene	477.04	2.6786	-0.003480	1.4084	25.61	-3.6724	0.0002126	-10.0234	9.47E-11
Anthracene	1311.64	3.1178	-0.001310	2.6397	436.18	0.7271	5.3341403	-1.6637	0.0218927
Fluoranthene	666.30	2.8237	-0.000490	2.6448	441.38	1.9294	84.999868	1.0352	10.843444
Fluorene	443.08	2.6465	-0.002130	1.8690	73.97	-1.2408	0.0574421	-5.1280	7.45E-06
Naphthalene	515.58	2.7123	-0.003860	1.3034	20.11	-4.3322	0.0000465	-11.3767	4.20E-12
Phenanthrene	1135.42	3.0552	-0.002408	2.1764	150.11	-1.3385	0.0458638	-5.7322	1.86E-06
Pyrene	443.38	2.6468	-0.000490	2.4679	293.72	1.7525	56.562463	0.8583	7.2156974
Total PAH:	5739.56				1838.96		201.27		24.68
Pentachlorophenol	56.84	1.7531	-0.001691	1.1359	13.67	-1.3330	0.0464536	-4.4191	0.0000381
Volatile aromatics:									
Benzene							0.00		0.00
Ethylbenzene							0.00		0.00
Styrene							0.00		0.00
Xylene							0.00		0.00

Southern Maryland Wood Treatment Site

Estimates of concentrations remaining after soil washing and oxidation by activated sludge ("bioslurry" process)
Source: Allen, pers. comm. 9/27/94

Basis:
1. Combination of soil washing and bioslurry process removes 95% of the original PAH mass in the treated soils.
2. All PAH compounds are equally affected by the process (which is likely to overestimate effectiveness).
3. Wash water is disposed of separately in compliance with RCRA, and is not included in the risk calculations.
4. All volatile aromatic compounds are assumed to be lost during the remediation process.

Contaminant	Initial Soil Conc. mg/kg	Final Soil Conc. mg/kg
Carcinogenic PAHs:		
Benzo[a]pyrene	44.56	2.23
Benzo[b]fluoranthene	51.67	2.58
Benzo[k]fluoranthene	53.54	2.68
Benz[a]anthracene	104.92	5.25
Carbazole	342.80	17.14
Chrysene	149.63	7.48
Total CPAH:	747.12	37.36
Noncarcinogenic PAHs:		
Acenaphthene	477.04	23.85
Anthracene	1311.64	65.58
Fluoranthene	666.30	33.31
Fluorene	443.08	22.15
Naphthalene	515.58	25.78
Phenanthrene	1135.42	56.77
Pyrene	443.38	22.17
Total PAH:	5739.56	286.98
Pentachlorophenol	56.64	2.83
Volatile aromatics:		
Benzene		0.00
Ethylbenzene		0.00
Styrene		0.00
Xylene		0.00

Southern Maryland Wood Treatment Site

Adult resident soil ingestion.
Remedial alternatives 1 and 2

Soil ingestion rate	*mg/d*	100
Exposure frequency	*d/y*	350
Exposure duration	*y*	24
Body weight	*kg*	70
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	8760

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.46E+01	2.09E-05	6.10E-05	1.53E-04	–
Benzo[b]fluoranthene	5.17E+01	2.43E-05	7.08E-05	1.77E-05	–
Benzo[k]fluoranthene	5.35E+01	2.51E-05	7.33E-05	1.84E-06	–
Benz[a]anthracene	1.05E+02	4.93E-05	1.44E-04	3.60E-05	–
Carbazole	3.43E+02	1.61E-04	4.70E-04	3.22E-06	–
Chrysene	1.50E+02	7.03E-05	2.05E-04	5.13E-07	–
Total CPAH:	7.47E+02			2.12E-04	–
Noncarcinogenic PAHs:					
Acenaphthene	4.77E+02	2.24E-04	6.53E-04	–	1.09E-02
Anthracene	1.31E+03	6.16E-04	1.80E-03	–	5.99E-03
Fluoranthene	6.66E+02	3.13E-04	9.13E-04	–	2.28E-02
Fluorene	4.43E+02	2.08E-04	6.07E-04	–	1.52E-02
Naphthalene	5.16E+02	2.42E-04	7.06E-04	–	1.77E-02
Phenanthrene	1.14E+03	5.33E-04	1.56E-03	–	3.89E-02
Pyrene	4.43E+02	2.08E-04	6.07E-04	–	2.02E-02
Total PAH:	5.74E+03			2.12E-04	1.32E-01
Pentachlorophenol	5.66E+01	2.66E-05	7.76E-05	3.19E-06	2.59E-03
Volatile aromatics:					
Benzene	3.10E-02	1.46E-08	4.25E-08	4.22E-10	–
Ethylbenzene	3.40E+00	1.60E-06	4.66E-06	–	4.66E-05
Styrene	1.90E+00	8.92E-07	2.60E-06	–	1.30E-05
Xylene	5.90E+00	2.77E-06	8.08E-06	–	4.04E-06
Total:				2.15E-04	1.34E-01

Southern Maryland Wood Treatment Site

Child resident soil ingestion.
Remedial alternatives 1 and 2

Soil ingestion rate	*mg/d*	**200**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.46E+01	4.88E-05	5.70E-04	3.57E-04	–
Benzo[b]fluoranthene	5.17E+01	5.66E-05	6.61E-04	4.13E-05	–
Benzo[k]fluoranthene	5.35E+01	5.87E-05	6.85E-04	4.28E-06	–
Benz[a]anthracene	1.05E+02	1.15E-04	1.34E-03	8.39E-05	–
Carbazole	3.43E+02	3.76E-04	4.38E-03	7.51E-06	–
Chrysene	1.50E+02	1.64E-04	1.91E-03	1.20E-06	–
Total CPAH:	7.47E+02			4.95E-04	–
Noncarcinogenic PAHs:					
Acenaphthene	4.77E+02	5.23E-04	6.10E-03	–	1.02E-01
Anthracene	1.31E+03	1.44E-03	1.68E-02	–	5.59E-02
Fluoranthene	6.66E+02	7.30E-04	8.52E-03	–	2.13E-01
Fluorene	4.43E+02	4.86E-04	5.66E-03	–	1.42E-01
Naphthalene	5.16E+02	5.65E-04	6.59E-03	–	1.65E-01
Phenanthrene	1.14E+03	1.24E-03	1.45E-02	–	3.63E-01
Pyrene	4.43E+02	4.86E-04	5.67E-03	–	1.89E-01
Total PAH:	5.74E+03			4.95E-04	1.23E+00
Pentachlorophenol	5.66E+01	6.21E-05	7.24E-04	7.45E-06	2.41E-02
Volatile aromatics:					
Benzene	3.10E-02	3.40E-08	3.96E-07	9.85E-10	–
Ethylbenzene	3.40E+00	3.73E-06	4.35E-05	–	4.35E-04
Styrene	1.90E+00	2.08E-06	2.43E-05	–	1.21E-04
Xylene	5.90E+00	6.47E-06	7.54E-05	–	3.77E-05
Total:				5.02E-04	1.25E+00

Southern Maryland Wood Treatment Site

Adult resident soil ingestion.
Remedial alternatives 6 and 7: postremedial risk

Soil ingestion rate	*mg/d*	**100**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.96E-02	2.80E-08	8.17E-08	2.04E-07	–
Benzo[b]fluoranthene	6.92E-02	3.25E-08	9.47E-08	2.37E-08	–
Benzo[k]fluoranthene	7.17E-02	3.37E-08	9.82E-08	2.46E-09	–
Benz[a]anthracene	1.40E-01	6.60E-08	1.92E-07	4.81E-08	–
Carbazole	4.59E-01	2.15E-07	6.29E-07	4.31E-09	–
Chrysene	2.00E-01	9.41E-08	2.74E-07	6.87E-10	–
Total CPAH:	1.00E+00			2.84E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	6.38E-01	3.00E-07	8.75E-07	–	1.46E-05
Anthracene	1.76E+00	8.25E-07	2.40E-06	–	8.02E-06
Fluoranthene	8.92E-01	4.19E-07	1.22E-06	–	3.05E-05
Fluorene	5.93E-01	2.79E-07	8.12E-07	–	2.03E-05
Naphthalene	6.90E-01	3.24E-07	9.45E-07	–	2.36E-05
Phenanthrene	1.52E+00	7.14E-07	2.08E-06	–	5.20E-05
Pyrene	5.93E-01	2.79E-07	8.13E-07	–	2.71E-05
Total PAH:	7.68E+00			2.84E-07	1.76E-04
Pentachlorophenol	7.58E-02	3.56E-08	1.04E-07	4.27E-09	3.46E-06
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.88E-07	1.80E-04

Southern Maryland Wood Treatment Site

Child resident soil ingestion.
Remedial alternatives 6 and 7: postremedial risk

Soil ingestion rate	*mg/d*	**200**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.96E-02	6.54E-08	7.63E-07	4.77E-07	–
Benzo[b]fluoranthene	6.92E-02	7.58E-08	8.84E-07	5.53E-08	–
Benzo[k]fluoranthene	7.17E-02	7.85E-08	9.16E-07	5.73E-09	–
Benz[a]anthracene	1.40E-01	1.54E-07	1.80E-06	1.12E-07	–
Carbazole	4.59E-01	5.03E-07	5.87E-06	1.01E-08	–
Chrysene	2.00E-01	2.19E-07	2.56E-06	1.60E-09	–
Total CPAH:	1.00E+00			6.62E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	6.38E-01	7.00E-07	8.16E-06	–	1.36E-04
Anthracene	1.76E+00	1.92E-06	2.24E-05	–	7.48E-05
Fluoranthene	8.92E-01	9.77E-07	1.14E-05	–	2.85E-04
Fluorene	5.93E-01	6.50E-07	7.58E-06	–	1.90E-04
Naphthalene	6.90E-01	7.56E-07	8.82E-06	–	2.21E-04
Phenanthrene	1.52E+00	1.67E-06	1.94E-05	–	4.86E-04
Pyrene	5.93E-01	6.50E-07	7.59E-06	–	2.53E-04
Total PAH:	7.68E+00			6.62E-07	1.64E-03
Pentachlorophenol	7.58E-02	8.31E-08	9.69E-07	9.97E-09	3.23E-05
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				6.72E-07	1.68E-03

Southern Maryland Wood Treatment Site

Adult resident soil ingestion.

Remedial alternative 8: postremedial risk after 5 years of composting

Soil ingestion rate	*mg/d*	100
Exposure frequency	*d/y*	350
Exposure duration	*y*	24
Body weight	*kg*	70
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	8760

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.68E+00	2.67E-06	7.79E-06	1.95E-05	–
Benzo[b]fluoranthene	6.59E+00	3.10E-06	9.03E-06	2.26E-06	–
Benzo[k]fluoranthene	6.83E+00	3.21E-06	9.36E-06	2.34E-07	–
Benz[a]anthracene	1.34E+01	6.29E-06	1.83E-05	4.59E-06	–
Carbazole	2.69E+00	1.26E-06	3.69E-06	2.53E-08	–
Chrysene	1.91E+01	8.97E-06	2.61E-05	6.54E-08	–
Total CPAH:	5.43E+01			2.67E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.13E-04	9.98E-11	2.91E-10	–	4.85E-09
Anthracene	5.33E+00	2.51E-06	7.31E-06	–	2.44E-05
Fluoranthene	8.50E+01	3.99E-05	1.16E-04	–	2.91E-03
Fluorene	5.74E-02	2.70E-08	7.87E-08	–	1.97E-06
Naphthalene	4.65E-05	2.19E-11	6.37E-11	–	1.59E-09
Phenanthrene	4.59E-02	2.15E-08	6.28E-08	–	1.57E-06
Pyrene	5.66E+01	2.66E-05	7.75E-05	–	2.58E-03
Total PAH:	2.01E+02			2.67E-05	5.52E-03
Pentachlorophenol	4.65E-02	2.18E-08	6.36E-08	2.62E-09	2.12E-06
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.67E-05	5.52E-03

Southern Maryland Wood Treatment Site

Child resident soil ingestion.

Remedial alternative 8: postremedial risk after 5 years of composting

Soil ingestion rate	*mg/d*	200
Exposure frequency	*d/y*	350
Exposure duration	*y*	6
Body weight	*kg*	15
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	2190

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.68E+00	6.23E-06	7.27E-05	4.55E-05	–
Benzo[b]fluoranthene	6.59E+00	7.22E-06	8.43E-05	5.27E-06	–
Benzo[k]fluoranthene	6.83E+00	7.49E-06	8.73E-05	5.46E-07	–
Benz[a]anthracene	1.34E+01	1.47E-05	1.71E-04	1.07E-05	–
Carbazole	2.69E+00	2.95E-06	3.44E-05	5.90E-08	–
Chrysene	1.91E+01	2.09E-05	2.44E-04	1.53E-07	–
Total CPAH:	5.43E+01			6.22E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.13E-04	2.33E-10	2.72E-09	–	4.53E-08
Anthracene	5.33E+00	5.85E-06	6.82E-05	–	2.27E-04
Fluoranthene	8.50E+01	9.32E-05	1.09E-03	–	2.72E-02
Fluorene	5.74E-02	6.30E-08	7.34E-07	–	1.84E-05
Naphthalene	4.65E-05	5.10E-11	5.95E-10	–	1.49E-08
Phenanthrene	4.59E-02	5.03E-08	5.86E-07	–	1.47E-05
Pyrene	5.66E+01	6.20E-05	7.23E-04	–	2.41E-02
Total PAH:	2.01E+02			6.22E-05	5.15E-02
Pentachlorophenol	4.65E-02	5.09E-08	5.94E-07	6.11E-09	1.98E-05
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				6.22E-05	5.16E-02

Southern Maryland Wood Treatment Site

Adult resident soil ingestion.

Remedial alternative 8: postremedial risk after 10 years of composting

Soil ingestion rate	*mg/d*	**100**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	7.25E-01	3.41E-07	9.93E-07	2.49E-06	–
Benzo[b]fluoranthene	8.41E-01	3.95E-07	1.15E-06	2.88E-07	–
Benzo[k]fluoranthene	8.71E-01	4.09E-07	1.19E-06	2.99E-08	–
Benz[a]anthracene	1.71E+00	8.02E-07	2.34E-06	5.85E-07	–
Carbazole	2.12E-02	9.93E-09	2.90E-08	1.99E-10	–
Chrysene	2.44E+00	1.14E-06	3.34E-06	8.35E-09	–
Total CPAH:	6.60E+00			3.40E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	9.47E-11	4.45E-17	1.30E-16	–	2.16E-15
Anthracene	2.17E-02	1.02E-08	2.97E-08	–	9.91E-08
Fluoranthene	1.08E+01	5.09E-06	1.49E-05	–	3.71E-04
Fluorene	7.45E-06	3.50E-12	1.02E-11	–	2.55E-10
Naphthalene	4.20E-12	1.97E-18	5.75E-18	–	1.44E-16
Phenanthrene	1.85E-06	8.70E-13	2.54E-12	–	6.34E-11
Pyrene	7.22E+00	3.39E-06	9.88E-06	–	3.29E-04
Total PAH:	2.47E+01			3.40E-06	7.01E-04
Pentachlorophenol	3.81E-05	1.79E-11	5.22E-11	2.15E-12	1.74E-09
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				3.40E-06	7.01E-04

Southern Maryland Wood Treatment Site

Child resident soil ingestion.

Remedial alternative 8: postremedial risk after 10 years of composting

Soil ingestion rate	*mg/d*	**200**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	7.25E-01	7.95E-07	9.27E-06	5.80E-06	–
Benzo[b]fluoranthene	8.41E-01	9.22E-07	1.08E-05	6.73E-07	–
Benzo[k]fluoranthene	8.71E-01	9.55E-07	1.11E-05	6.97E-08	–
Benz[a]anthracene	1.71E+00	1.87E-06	2.18E-05	1.37E-06	–
Carbazole	2.12E-02	2.32E-08	2.70E-07	4.64E-10	–
Chrysene	2.44E+00	2.67E-06	3.11E-05	1.95E-08	–
Total CPAH:	6.60E+00			7.93E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	9.47E-11	1.04E-16	1.21E-15	–	2.02E-14
Anthracene	2.17E-02	2.38E-08	2.77E-07	–	9.25E-07
Fluoranthene	1.08E+01	1.19E-05	1.39E-04	–	3.47E-03
Fluorene	7.45E-06	8.16E-12	9.52E-11	–	2.38E-09
Naphthalene	4.20E-12	4.60E-18	5.37E-17	–	1.34E-15
Phenanthrene	1.85E-06	2.03E-12	2.37E-11	–	5.92E-10
Pyrene	7.22E+00	7.91E-06	9.23E-05	–	3.08E-03
Total PAH:	2.47E+01			7.93E-06	6.54E-03
Pentachlorophenol	3.81E-05	4.18E-11	4.87E-10	5.01E-12	1.62E-08
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				7.93E-06	6.54E-03

Southern Maryland Wood Treatment Site

Adult resident soil ingestion.

Remedial alternative 9: postremedial risk after bio-oxidation with actibated sludge process

Soil ingestion rate	*mg/d*	**100**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	2.23E+00	1.05E-06	3.05E-06	7.64E-06	–
Benzo[b]fluoranthene	2.58E+00	1.21E-06	3.54E-06	8.86E-07	–
Benzo[k]fluoranthene	2.68E+00	1.26E-06	3.67E-06	9.18E-08	–
Benz[a]anthracene	5.25E+00	2.46E-06	7.19E-06	1.80E-06	–
Carbazole	1.71E+01	8.05E-06	2.35E-05	1.61E-07	–
Chrysene	7.48E+00	3.51E-06	1.02E-05	2.57E-08	–
Total CPAH:	3.74E+01			1.06E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.39E+01	1.12E-05	3.27E-05	–	5.45E-04
Anthracene	6.56E+01	3.08E-05	8.98E-05	–	2.99E-04
Fluoranthene	3.33E+01	1.56E-05	4.56E-05	–	1.14E-03
Fluorene	2.22E+01	1.04E-05	3.03E-05	–	7.59E-04
Naphthalene	2.58E+01	1.21E-05	3.53E-05	–	8.83E-04
Phenanthrene	5.68E+01	2.67E-05	7.78E-05	–	1.94E-03
Pyrene	2.22E+01	1.04E-05	3.04E-05	–	1.01E-03
Total PAH:	2.87E+02			1.06E-05	6.58E-03
Pentachlorophenol	2.83E+00	1.33E-06	3.88E-06	1.60E-07	1.29E-04
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				1.08E-05	6.71E-03

Southern Maryland Wood Treatment Site

Child resident soil ingestion.

Remedial alternative 9: postremedial risk after bio-oxidation with actibated sludge process

Soil ingestion rate	*mg/d*	**200**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	2.23E+00	2.44E-06	2.85E-05	1.78E-05	–
Benzo[b]fluoranthene	2.58E+00	2.83E-06	3.30E-05	2.07E-06	–
Benzo[k]fluoranthene	2.68E+00	2.93E-06	3.42E-05	2.14E-07	–
Benz[a]anthracene	5.25E+00	5.75E-06	6.71E-05	4.20E-06	–
Carbazole	1.71E+01	1.88E-05	2.19E-04	3.76E-07	–
Chrysene	7.48E+00	8.20E-06	9.57E-05	5.99E-08	–
Total CPAH:	3.74E+01			2.47E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.39E+01	2.61E-05	3.05E-04	–	5.08E-03
Anthracene	6.56E+01	7.19E-05	8.38E-04	–	2.79E-03
Fluoranthene	3.33E+01	3.65E-05	4.26E-04	–	1.06E-02
Fluorene	2.22E+01	2.43E-05	2.83E-04	–	7.08E-03
Naphthalene	2.58E+01	2.83E-05	3.30E-04	–	8.24E-03
Phenanthrene	5.68E+01	6.22E-05	7.26E-04	–	1.81E-02
Pyrene	2.22E+01	2.43E-05	2.83E-04	–	9.45E-03
Total PAH:	2.87E+02			2.47E-05	6.14E-02
Pentachlorophenol	2.83E+00	3.10E-06	3.62E-05	3.72E-07	1.21E-03
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.51E-05	6.26E-02

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternatives 1 and 2: postremedial risks at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	RME Conc. mg/m3	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
Carcinogenic PAHs:					
Benzo[a]pyrene	4.25E-08	3.99E-09	1.17E-08	2.44E-08	–
Benzo[b]fluoranthene	5.14E-08	4.83E-09	1.41E-08	2.95E-09	–
Benzo[k]fluoranthene	4.71E-08	4.43E-09	1.29E-08	2.70E-10	–
Benz[a]anthracene	7.04E-08	6.61E-09	1.93E-08	4.03E-09	–
Carbazole	5.87E-08	5.51E-09	1.61E-08	1.10E-10	–
Chrysene	1.08E-07	1.01E-08	2.95E-08	6.17E-11	–
Total CPAH:	3.78E-07			3.18E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	1.37E-07	1.29E-08	3.75E-08	–	6.26E-07
Anthracene	2.25E-07	2.11E-08	6.16E-08	–	2.05E-07
Fluoranthene	4.20E-07	3.95E-08	1.15E-07	–	2.88E-06
Fluorene	9.78E-08	9.18E-09	2.68E-08	–	6.70E-07
Naphthalene	6.50E-03	6.11E-04	1.78E-03	–	4.45E-02
Phenanthrene	2.44E-07	2.30E-08	6.70E-08	–	1.67E-06
Pyrene	3.81E-07	3.58E-08	1.04E-07	–	3.48E-06
Total PAH:	6.50E-03			3.18E-08	4.45E-02
Pentachlorophenol	1.76E-07	1.65E-08	4.82E-08	1.98E-09	–
Volatile aromatics:					
Benzene	3.10E-05	2.91E-06	8.49E-06	8.44E-08	4.97E-03
Ethylbenzene	1.04E-03	9.74E-05	2.84E-04	–	9.93E-04
Styrene	3.10E-04	2.91E-05	8.49E-05	–	2.97E-04
Xylene	1.29E-03	1.22E-04	3.55E-04	–	1.77E-03
Total:				1.18E-07	5.26E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.
Remedial alternatives 1 and 2: postremedial risks at fence line

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.25E-08	2.80E-09	3.26E-08	1.71E-08	–
Benzo[b]fluoranthene	5.14E-08	3.38E-09	3.94E-08	2.06E-09	–
Benzo[k]fluoranthene	4.71E-08	3.10E-09	3.62E-08	1.89E-10	–
Benz[a]anthracene	7.04E-08	4.63E-09	5.40E-08	2.82E-09	–
Carbazole	5.87E-08	3.86E-09	4.50E-08	7.72E-11	–
Chrysene	1.08E-07	7.08E-09	8.25E-08	4.32E-11	–
Total CPAH:	3.78E-07			2.23E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	1.37E-07	9.01E-09	1.05E-07	–	1.75E-06
Anthracene	2.25E-07	1.48E-08	1.73E-07	–	5.75E-07
Fluoranthene	4.20E-07	2.76E-08	3.22E-07	–	8.05E-06
Fluorene	9.78E-08	6.43E-09	7.50E-08	–	1.88E-06
Naphthalene	6.50E-03	4.27E-04	4.99E-03	–	1.25E-01
Phenanthrene	2.44E-07	1.61E-08	1.87E-07	–	4.69E-06
Pyrene	3.81E-07	2.51E-08	2.93E-07	–	9.75E-06
Total PAH:	6.50E-03			2.23E-08	1.25E-01
Pentachlorophenol	1.76E-07	1.16E-08	1.35E-07	1.39E-09	–
Volatile aromatics:					
Benzene	3.10E-05	2.04E-06	2.38E-05	5.91E-08	1.39E-02
Ethylbenzene	1.04E-03	6.82E-05	7.96E-04	–	2.78E-03
Styrene	3.10E-04	2.04E-05	2.38E-04	–	8.31E-04
Xylene	1.29E-03	8.51E-05	9.93E-04	–	4.96E-03
Total:				8.28E-08	1.47E-01

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternative 3: postremedial risks at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	–	–	–	–	–
Benzo[b]fluoranthene	–	–	–	–	–
Benzo[k]fluoranthene	–	–	–	–	–
Benz[a]anthracene	–	–	–	–	–
Carbazole	–	–	–	–	–
Chrysene	–	–	–	–	–
Total CPAH:	–			–	–
Noncarcinogenic PAHs:					
Acenaphthene	–	–	–	–	–
Anthracene	–	–	–	–	–
Fluoranthene	–	–	–	–	–
Fluorene	–	–	–	–	–
Naphthalene	6.50E-03	6.11E-04	1.78E-03	–	4.45E-02
Phenanthrene	–	–	–	–	–
Pyrene	–	–	–	–	–
Total PAH:	6.50E-03			–	4.45E-02
Pentachlorophenol	–	–	–	–	–
Volatile aromatics:					
Benzene	3.10E-05	2.91E-06	8.49E-06	8.44E-08	4.97E-03
Ethylbenzene	1.04E-03	9.74E-05	2.84E-04	–	9.93E-04
Styrene	3.10E-04	2.91E-05	8.49E-05	–	2.97E-04
Xylene	1.29E-03	1.22E-04	3.55E-04	–	1.77E-03
Total:				8.44E-08	5.26E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternative 3: postremedial risks at fence line

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	–	–	–	–	–
Benzo[b]fluoranthene	–	–	–	–	–
Benzo[k]fluoranthene	–	–	–	–	–
Benz[a]anthracene	–	–	–	–	–
Carbazole	–	–	–	–	–
Chrysene	–	–	–	–	–
Total CPAH:	–			–	–
Noncarcinogenic PAHs:					
Acenaphthene	–	–	–	–	–
Anthracene	–	–	–	–	–
Fluoranthene	–	–	–	–	–
Fluorene	–	–	–	–	–
Naphthalene	6.50E-03	4.27E-04	4.99E-03	–	1.25E-01
Phenanthrene	–	–	–	–	–
Pyrene	–	–	–	–	–
Total PAH:	6.50E-03			–	1.25E-01
Pentachlorophenol	–	–	–	–	–
Volatile aromatics:					
Benzene	3.10E-05	2.04E-06	2.38E-05	5.91E-08	1.39E-02
Ethylbenzene	1.04E-03	6.82E-05	7.96E-04	–	2.78E-03
Styrene	3.10E-04	2.04E-05	2.38E-04	–	8.31E-04
Xylene	1.29E-03	8.51E-05	9.93E-04	–	4.96E-03
Total:				5.91E-08	1.47E-01

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternative 4: risks during remediation at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	3.69E-06	2.89E-08	1.01E-06	1.76E-07	–
Benzo[b]fluoranthene	4.46E-06	3.49E-08	1.22E-06	2.13E-08	–
Benzo[k]fluoranthene	4.09E-06	3.20E-08	1.12E-06	1.95E-09	–
Benz[a]anthracene	6.11E-06	4.78E-08	1.67E-06	2.92E-08	–
Carbazole	5.09E-06	3.98E-08	1.39E-06	7.97E-10	–
Chrysene	9.33E-06	7.30E-08	2.56E-06	4.46E-10	–
Total CPAH:	3.28E-05			2.30E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	1.19E-05	9.29E-08	3.25E-06	–	5.42E-05
Anthracene	1.95E-05	1.53E-07	5.35E-06	–	1.78E-05
Fluoranthene	3.65E-05	2.85E-07	9.99E-06	–	2.50E-04
Fluorene	8.48E-06	6.64E-08	2.32E-06	–	5.81E-05
Naphthalene	7.15E-06	5.60E-08	1.96E-06	–	4.90E-05
Phenanthrene	2.12E-05	1.66E-07	5.81E-06	–	1.45E-04
Pyrene	3.31E-05	2.59E-07	9.06E-06	–	3.02E-04
Total PAH:	1.71E-04			2.30E-07	8.76E-04
Pentachlorophenol	1.53E-05	1.20E-07	4.18E-06	1.43E-08	–
Volatile aromatics:					
Benzene	2.60E-05	2.04E-07	7.12E-06	5.90E-09	4.17E-03
Ethylbenzene	2.82E-03	2.21E-05	7.73E-04	–	2.70E-03
Styrene	1.58E-03	1.23E-05	4.32E-04	–	1.51E-03
Xylene	4.90E-03	3.83E-05	1.34E-03	–	6.71E-03
Total:				2.50E-07	1.60E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternative 4: risks during remediation at fence line

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	3.69E-06	8.09E-08	2.83E-06	4.93E-07	–
Benzo[b]fluoranthene	4.46E-06	9.78E-08	3.42E-06	5.97E-08	–
Benzo[k]fluoranthene	4.09E-06	8.96E-08	3.14E-06	5.47E-09	–
Benz[a]anthracene	6.11E-06	1.34E-07	4.68E-06	8.16E-08	–
Carbazole	5.09E-06	1.12E-07	3.90E-06	2.23E-09	–
Chrysene	9.33E-06	2.04E-07	7.16E-06	1.25E-09	–
Total CPAH:	3.28E-05			6.44E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	1.19E-05	2.60E-07	9.11E-06	–	1.52E-04
Anthracene	1.95E-05	4.28E-07	1.50E-05	–	4.99E-05
Fluoranthene	3.65E-05	7.99E-07	2.80E-05	–	6.99E-04
Fluorene	8.48E-06	1.86E-07	6.51E-06	–	1.63E-04
Naphthalene	7.15E-06	1.57E-07	5.48E-06	–	1.37E-04
Phenanthrene	2.12E-05	4.65E-07	1.63E-05	–	4.07E-04
Pyrene	3.31E-05	7.25E-07	2.54E-05	–	8.46E-04
Total PAH:	1.71E-04			6.44E-07	2.45E-03
Pentachlorophenol	1.53E-05	3.35E-07	1.17E-05	4.02E-08	–
Volatile aromatics:					
Benzene	2.60E-05	5.70E-07	1.99E-05	1.65E-08	1.17E-02
Ethylbenzene	2.82E-03	6.19E-05	2.17E-03	–	7.57E-03
Styrene	1.58E-03	3.46E-05	1.21E-03	–	4.23E-03
Xylene	4.90E-03	1.07E-04	3.76E-03	–	1.88E-02
Total:				7.00E-07	4.47E-02

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternative 5: risks during remediation at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.22E-06	9.51E-09	3.33E-07	5.80E-08	–
Benzo[b]fluoranthene	1.47E-06	1.15E-08	4.02E-07	7.01E-09	–
Benzo[k]fluoranthene	1.35E-06	1.05E-08	3.69E-07	6.43E-10	–
Benz[a]anthracene	2.01E-06	1.57E-08	5.51E-07	9.60E-09	–
Carbazole	1.68E-06	1.31E-08	4.59E-07	2.62E-10	–
Chrysene	3.07E-06	2.40E-08	8.42E-07	1.47E-10	–
Total CPAH:	1.08E-05			7.57E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	3.91E-06	3.06E-08	1.07E-06	–	1.78E-05
Anthracene	6.42E-06	5.03E-08	1.76E-06	–	5.87E-06
Fluoranthene	1.20E-05	9.40E-08	3.29E-06	–	8.23E-05
Fluorene	2.79E-06	2.19E-08	7.65E-07	–	1.91E-05
Naphthalene	3.57E-06	2.79E-08	9.78E-07	–	2.44E-05
Phenanthrene	6.98E-06	5.46E-08	1.91E-06	–	4.78E-05
Pyrene	1.09E-05	8.52E-08	2.98E-06	–	9.95E-05
Total PAH:	5.74E-05			7.57E-08	2.97E-04
Pentachlorophenol	5.03E-06	3.94E-08	1.38E-06	4.72E-09	–
Volatile aromatics:					
Benzene	2.60E-05	2.04E-07	7.12E-06	5.90E-09	4.17E-03
Ethylbenzene	2.82E-03	2.21E-05	7.73E-04	–	2.70E-03
Styrene	1.58E-03	1.23E-05	4.32E-04	–	1.51E-03
Xylene	4.90E-03	3.83E-05	1.34E-03	–	6.71E-03
Total:				8.63E-08	1.54E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.
Remedial alternative 5: risks during remediation at fence line

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.22E-06	2.66E-08	9.32E-07	1.62E-07	–
Benzo[b]fluoranthene	1.47E-06	3.22E-08	1.13E-06	1.96E-08	–
Benzo[k]fluoranthene	1.35E-06	2.95E-08	1.03E-06	1.80E-09	–
Benz[a]anthracene	2.01E-06	4.41E-08	1.54E-06	2.69E-08	–
Carbazole	1.68E-06	3.67E-08	1.29E-06	7.35E-10	–
Chrysene	3.07E-06	6.73E-08	2.36E-06	4.11E-10	–
Total CPAH:	1.08E-05			2.12E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	3.91E-06	8.57E-08	3.00E-06	–	5.00E-05
Anthracene	6.42E-06	1.41E-07	4.93E-06	–	1.64E-05
Fluoranthene	1.20E-05	2.63E-07	9.21E-06	–	2.30E-04
Fluorene	2.79E-06	6.12E-08	2.14E-06	–	5.36E-05
Naphthalene	3.57E-06	7.82E-08	2.74E-06	–	6.84E-05
Phenanthrene	6.98E-06	1.53E-07	5.36E-06	–	1.34E-04
Pyrene	1.09E-05	2.39E-07	8.35E-06	–	2.78E-04
Total PAH:	5.74E-05			2.12E-07	8.31E-04
Pentachlorophenol	5.03E-06	1.10E-07	3.86E-06	1.32E-08	–
Volatile aromatics:					
Benzene	2.60E-05	5.70E-07	1.99E-05	1.65E-08	1.17E-02
Ethylbenzene	2.82E-03	6.19E-05	2.17E-03	–	7.57E-03
Styrene	1.58E-03	3.46E-05	1.21E-03	–	4.23E-03
Xylene	4.90E-03	1.07E-04	3.76E-03	–	1.88E-02
Total:				2.42E-07	4.31E-02

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternatives 6 and 7: risks from excavation and materials handling only at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	9.71E-07	7.60E-09	2.66E-07	4.64E-08	–
Benzo[b]fluoranthene	1.18E-06	9.20E-09	3.22E-07	5.61E-09	–
Benzo[k]fluoranthene	1.08E-06	8.42E-09	2.95E-07	5.14E-10	–
Benz[a]anthracene	1.61E-06	1.26E-08	4.41E-07	7.68E-09	–
Carbazole	1.34E-06	1.05E-08	3.67E-07	2.10E-10	–
Chrysene	2.46E-06	1.92E-08	6.73E-07	1.17E-10	–
Total CPAH:	8.63E-06			6.05E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	3.13E-06	2.45E-08	8.56E-07	–	1.43E-05
Anthracene	5.14E-06	4.02E-08	1.41E-06	–	4.69E-06
Fluoranthene	9.60E-06	7.52E-08	2.63E-06	–	6.58E-05
Fluorene	2.23E-06	1.75E-08	6.12E-07	–	1.53E-05
Naphthalene	1.88E-06	1.47E-08	5.16E-07	–	1.29E-05
Phenanthrene	5.59E-06	4.37E-08	1.53E-06	–	3.83E-05
Pyrene	8.71E-06	6.82E-08	2.39E-06	–	7.95E-05
Total PAH:	4.49E-05			6.05E-08	2.31E-04
Pentachlorophenol	4.02E-06	3.15E-08	1.10E-06	3.78E-09	–
Volatile aromatics:					
Benzene	2.60E-05	2.04E-07	7.12E-06	5.90E-09	4.17E-03
Ethylbenzene	2.82E-03	2.21E-05	7.73E-04	–	2.70E-03
Styrene	1.58E-03	1.23E-05	4.32E-04	–	1.51E-03
Xylene	4.90E-03	3.83E-05	1.34E-03	–	6.71E-03
Total:				7.02E-08	1.53E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternatives 6 and 7: risks from excavation and materials handling only at fence line

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	9.71E-07	2.13E-08	7.45E-07	1.30E-07	–
Benzo[b]fluoranthene	1.18E-06	2.58E-08	9.01E-07	1.57E-08	–
Benzo[k]fluoranthene	1.08E-06	2.36E-08	8.25E-07	1.44E-09	–
Benz[a]anthracene	1.61E-06	3.52E-08	1.23E-06	2.15E-08	–
Carbazole	1.34E-06	2.94E-08	1.03E-06	5.87E-10	–
Chrysene	2.46E-06	5.38E-08	1.88E-06	3.28E-10	–
Total CPAH:	8.63E-06			1.69E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	3.13E-06	6.85E-08	2.40E-06	–	4.00E-05
Anthracene	5.14E-06	1.13E-07	3.94E-06	–	1.31E-05
Fluoranthene	9.60E-06	2.10E-07	7.37E-06	–	1.84E-04
Fluorene	2.23E-06	4.89E-08	1.71E-06	–	4.28E-05
Naphthalene	1.88E-06	4.13E-08	1.44E-06	–	3.61E-05
Phenanthrene	5.59E-06	1.22E-07	4.28E-06	–	1.07E-04
Pyrene	8.71E-06	1.91E-07	6.68E-06	–	2.23E-04
Total PAH:	4.49E-05			1.69E-07	6.46E-04
Pentachlorophenol	4.02E-06	8.81E-08	3.08E-06	1.06E-08	–
Volatile aromatics:					
Benzene	2.60E-05	5.70E-07	1.99E-05	1.65E-08	1.17E-02
Ethylbenzene	2.82E-03	6.19E-05	2.17E-03	–	7.57E-03
Styrene	1.58E-03	3.46E-05	1.21E-03	–	4.23E-03
Xylene	4.90E-03	1.07E-04	3.76E-03	–	1.88E-02
Total:				1.97E-07	4.29E-02

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternative 6: risks from incinerator only

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.43E-08	1.12E-10	3.92E-09	6.83E-10	–
Benzo[b]fluoranthene	3.54E-09	2.77E-11	9.70E-10	1.69E-11	–
Benzo[k]fluoranthene	1.25E-08	9.78E-11	3.42E-09	5.97E-12	–
Benz[a]anthracene	3.27E-08	2.56E-10	8.96E-09	1.56E-10	–
Carbazole	1.18E-07	9.25E-10	3.24E-08	1.85E-11	–
Chrysene	2.45E-09	1.92E-11	6.71E-10	1.17E-13	–
Total CPAH:	1.84E-07			8.80E-10	–
Noncarcinogenic PAHs:					
Acenaphthene	1.64E-07	1.29E-09	4.51E-08	–	7.51E-07
Anthracene	4.52E-07	3.54E-09	1.24E-07	–	4.13E-07
Fluoranthene	2.30E-07	1.80E-09	6.29E-08	–	1.57E-06
Fluorene	1.53E-07	1.20E-09	4.19E-08	–	1.05E-06
Naphthalene	1.78E-07	1.39E-09	4.87E-08	–	1.22E-06
Phenanthrene	3.92E-07	3.06E-09	1.07E-07	–	2.68E-06
Pyrene	1.53E-07	1.20E-09	4.19E-08	–	1.40E-06
Total PAH:	1.91E-06			8.80E-10	9.08E-06
Pentachlorophenol	2.72E-08	2.13E-10	7.45E-09	2.55E-11	–
Volatile aromatics:					
Benzene		–	–	–	–
Ethylbenzene		–	–	–	–
Styrene		–	–	–	–
Xylene		–	–	–	–
Total:				9.06E-10	9.08E-06

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.
Remedial alternative 6: risks from incinerator only

Inhalation rate	*m3/d*	12
Exposure frequency	*d/y*	350
Exposure duration	*y*	2
Body weight	*kg*	15
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	730

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.43E-08	3.13E-10	1.10E-08	1.91E-09	–
Benzo[b]fluoranthene	3.54E-09	7.76E-11	2.72E-09	4.73E-11	–
Benzo[k]fluoranthene	1.25E-08	2.74E-10	9.59E-09	1.67E-11	–
Benz[a]anthracene	3.27E-08	7.17E-10	2.51E-08	4.37E-10	–
Carbazole	1.18E-07	2.59E-09	9.07E-08	5.18E-11	–
Chrysene	2.45E-09	5.37E-11	1.88E-09	3.28E-13	–
Total CPAH:	1.84E-07			2.47E-09	–
Noncarcinogenic PAHs:					
Acenaphthene	1.64E-07	3.61E-09	1.26E-07	–	2.10E-06
Anthracene	4.52E-07	9.91E-09	3.47E-07	–	1.16E-06
Fluoranthene	2.30E-07	5.04E-09	1.76E-07	–	4.41E-06
Fluorene	1.53E-07	3.35E-09	1.17E-07	–	2.93E-06
Naphthalene	1.78E-07	3.90E-09	1.36E-07	–	3.41E-06
Phenanthrene	3.92E-07	8.58E-09	3.00E-07	–	7.51E-06
Pyrene	1.53E-07	3.35E-09	1.17E-07	–	3.91E-06
Total PAH:	1.91E-06			2.47E-09	2.54E-05
Pentachlorophenol	2.72E-08	5.96E-10	2.09E-08	7.15E-11	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.54E-09	2.54E-05

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
*Remedial alternative 7: risks from thermal desorber only at location 82 m away**

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.08E-05	8.45E-08	2.96E-06	5.16E-07	–
Benzo[b]fluoranthene	1.30E-05	1.02E-07	3.56E-06	6.21E-08	–
Benzo[k]fluoranthene	1.19E-05	9.32E-08	3.26E-06	5.68E-09	–
Benz[a]anthracene	1.78E-05	1.39E-07	4.88E-06	8.50E-08	–
Carbazole	1.49E-05	1.17E-07	4.08E-06	2.33E-09	–
Chrysene	2.72E-05	2.13E-07	7.45E-06	1.30E-09	–
Total CPAH:	9.56E-05			6.72E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	3.47E-05	2.72E-07	9.51E-06	–	1.58E-04
Anthracene	5.70E-05	4.46E-07	1.56E-05	–	5.21E-05
Fluoranthene	1.06E-04	8.30E-07	2.90E-05	–	7.26E-04
Fluorene	2.48E-05	1.94E-07	6.79E-06	–	1.70E-04
Naphthalene	2.08E-05	1.63E-07	5.70E-06	–	1.42E-04
Phenanthrene	6.19E-05	4.85E-07	1.70E-05	–	4.24E-04
Pyrene	9.66E-05	7.56E-07	2.65E-05	–	8.82E-04
Total PAH:	4.97E-04			6.72E-07	2.56E-03
Pentachlorophenol	4.46E-05	3.49E-07	1.22E-05	4.19E-08	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				7.14E-07	2.56E-03

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.
*Remedial alternative 7: risks from thermal desorber only at location 82 m away**

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.08E-05	2.37E-07	8.28E-06	1.44E-06	–
Benzo[b]fluoranthene	1.30E-05	2.85E-07	9.97E-06	1.74E-07	–
Benzo[k]fluoranthene	1.19E-05	2.61E-07	9.13E-06	1.59E-08	–
Benz[a]anthracene	1.78E-05	3.90E-07	1.37E-05	2.38E-07	–
Carbazole	1.49E-05	3.27E-07	1.14E-05	6.53E-09	–
Chrysene	2.72E-05	5.96E-07	2.09E-05	3.64E-09	–
Total CPAH:	9.56E-05			1.88E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	3.47E-05	7.61E-07	2.66E-05	–	4.44E-04
Anthracene	5.70E-05	1.25E-06	4.37E-05	–	1.46E-04
Fluoranthene	1.06E-04	2.32E-06	8.13E-05	–	2.03E-03
Fluorene	2.48E-05	5.44E-07	1.90E-05	–	4.76E-04
Naphthalene	2.08E-05	4.56E-07	1.60E-05	–	3.99E-04
Phenanthrene	6.19E-05	1.36E-06	4.75E-05	–	1.19E-03
Pyrene	9.66E-05	2.12E-06	7.41E-05	–	2.47E-03
Total PAH:	4.97E-04			1.88E-06	7.15E-03
Pentachlorophenol	4.46E-05	9.78E-07	3.42E-05	1.17E-07	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.00E-06	7.15E-03

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.

Remedial alternatives 8 & 9: risks from excavation and materials handling for 2 years, at fence line

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**2**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**730**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	RME Conc. mg/m3	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
Carcinogenic PAHs:					
Benzo[a]pyrene	9.71E-07	7.60E-09	2.66E-07	4.64E-08	–
Benzo[b]fluoranthene	1.18E-06	9.20E-09	3.22E-07	5.61E-09	–
Benzo[k]fluoranthene	1.08E-06	8.42E-09	2.95E-07	5.14E-10	–
Benz[a]anthracene	1.61E-06	1.26E-08	4.41E-07	7.68E-09	–
Carbazole	1.34E-06	1.05E-08	3.67E-07	2.10E-10	–
Chrysene	2.46E-06	1.92E-08	6.73E-07	1.17E-10	–
Total CPAH:	8.63E-06			6.05E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	3.13E-06	2.45E-08	8.56E-07	–	1.43E-05
Anthracene	5.14E-06	4.02E-08	1.41E-06	–	4.69E-06
Fluoranthene	9.60E-06	7.52E-08	2.63E-06	–	6.58E-05
Fluorene	2.23E-06	1.75E-08	6.12E-07	–	1.53E-05
Naphthalene	1.88E-06	1.47E-08	5.16E-07	–	1.29E-05
Phenanthrene	5.59E-06	4.37E-08	1.53E-06	–	3.83E-05
Pyrene	8.71E-06	6.82E-08	2.39E-06	–	7.95E-05
Total PAH:	4.49E-05			6.05E-08	2.31E-04
Pentachlorophenol	4.02E-06	3.15E-08	1.10E-06	3.78E-09	–
Volatile aromatics:					
Benzene	2.60E-05	2.04E-07	7.12E-06	5.90E-09	4.17E-03
Ethylbenzene	2.82E-03	2.21E-05	7.73E-04	–	2.70E-03
Styrene	1.58E-03	1.23E-05	4.32E-04	–	1.51E-03
Xylene	4.90E-03	3.83E-05	1.34E-03	–	6.71E-03
Total:				7.02E-08	1.53E-02

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternatives 8 & 9: risks from excavation and materials handling for 2 years, at fence line

Inhalation rate	*m3/d*	12
Exposure frequency	*d/y*	350
Exposure duration	*y*	2
Body weight	*kg*	15
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	730

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	9.71E-07	2.13E-08	7.45E-07	1.30E-07	–
Benzo[b]fluoranthene	1.18E-06	2.58E-08	9.01E-07	1.57E-08	–
Benzo[k]fluoranthene	1.08E-06	2.36E-08	8.25E-07	1.44E-09	–
Benz[a]anthracene	1.61E-06	3.52E-08	1.23E-06	2.15E-08	–
Carbazole	1.34E-06	2.94E-08	1.03E-06	5.87E-10	–
Chrysene	2.46E-06	5.38E-08	1.88E-06	3.28E-10	–
Total CPAH:	8.63E-06			1.69E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	3.13E-06	6.85E-08	2.40E-06	–	4.00E-05
Anthracene	5.14E-06	1.13E-07	3.94E-06	–	1.31E-05
Fluoranthene	9.60E-06	2.10E-07	7.37E-06	–	1.84E-04
Fluorene	2.23E-06	4.89E-08	1.71E-06	–	4.28E-05
Naphthalene	1.88E-06	4.13E-08	1.44E-06	–	3.61E-05
Phenanthrene	5.59E-06	1.22E-07	4.28E-06	–	1.07E-04
Pyrene	8.71E-06	1.91E-07	6.68E-06	–	2.23E-04
Total PAH:	4.49E-05			1.69E-07	6.46E-04
Pentachlorophenol	4.02E-06	8.81E-08	3.08E-06	1.06E-08	–
Volatile aromatics:					
Benzene	2.60E-05	5.70E-07	1.99E-05	1.65E-08	1.17E-02
Ethylbenzene	2.82E-03	6.19E-05	2.17E-03	–	7.57E-03
Styrene	1.58E-03	3.46E-05	1.21E-03	–	4.23E-03
Xylene	4.90E-03	1.07E-04	3.76E-03	–	8.45E-02
Total:				1.97E-07	4.29E-02

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.
Remedial alternative 8: risks from air emissions during composting

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**9**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**3285**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.39E-05	4.90E-07	3.81E-06	2.99E-06	–
Benzo[b]fluoranthene	8.23E-07	2.90E-08	2.25E-07	1.77E-08	–
Benzo[k]fluoranthene	8.23E-07	2.90E-08	2.25E-07	1.77E-09	–
Benz[a]anthracene	6.60E-05	2.32E-06	1.81E-05	1.42E-06	–
Carbazole	2.32E-05	8.17E-07	6.36E-06	1.63E-08	–
Chrysene	1.21E-05	4.26E-07	3.32E-06	2.60E-09	–
Total CPAH:	1.17E-04			4.44E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	4.11E-05	1.45E-06	1.13E-05	–	1.88E-04
Anthracene	5.91E-05	2.08E-06	1.62E-05	–	5.40E-05
Fluoranthene	3.86E-06	1.36E-07	1.06E-06	–	2.64E-05
Fluorene	1.89E-04	6.66E-06	5.18E-05	–	1.29E-03
Naphthalene	1.26E-04	4.44E-06	3.45E-05	–	8.63E-04
Phenanthrene	3.94E-05	1.39E-06	1.08E-05	–	2.70E-04
Pyrene	–	–	–	–	–
Total PAH:	5.75E-04			4.44E-06	2.70E-03
Pentachlorophenol	2.84E-05	1.00E-06	7.78E-06	1.20E-07	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				4.56E-06	2.70E-03

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternative 8: risks from air emissions during composting

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	RME Conc. mg/m3	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
Carcinogenic PAHs:					
Benzo[a]pyrene	1.39E-05	9.14E-07	1.07E-05	5.58E-06	–
Benzo[b]fluoranthene	8.23E-07	5.41E-08	6.31E-07	3.30E-08	–
Benzo[k]fluoranthene	8.23E-07	5.41E-08	6.31E-07	3.30E-09	–
Benz[a]anthracene	6.60E-05	4.34E-06	5.06E-05	2.65E-06	–
Carbazole	2.32E-05	1.53E-06	1.78E-05	3.05E-08	–
Chrysene	1.21E-05	7.96E-07	9.28E-06	4.85E-09	–
Total CPAH:	1.17E-04			8.29E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	4.11E-05	2.70E-06	3.15E-05	–	5.25E-04
Anthracene	5.91E-05	3.89E-06	4.53E-05	–	1.51E-04
Fluoranthene	3.86E-06	2.54E-07	2.96E-06	–	7.40E-05
Fluorene	1.89E-04	1.24E-05	1.45E-04	–	3.62E-03
Naphthalene	1.26E-04	8.28E-06	9.67E-05	–	2.42E-03
Phenanthrene	3.94E-05	2.59E-06	3.02E-05	–	7.56E-04
Pyrene	–	–	–	–	–
Total PAH:	5.75E-04			8.29E-06	7.55E-03
Pentachlorophenol	2.84E-05	1.87E-06	2.18E-05	2.24E-07	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				8.52E-06	7.55E-03

Southern Maryland Wood Treatment Site

Adult resident ambient air inhalation.

Remedial alternative 9: risks from air emissions during bio-oxidation with activated sludge

Inhalation rate	*m3/d*	**20**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**9**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**3285**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	3.44E-08	1.21E-09	9.42E-09	7.39E-09	–
Benzo[b]fluoranthene	2.25E-06	7.93E-08	6.16E-07	4.83E-08	–
Benzo[k]fluoranthene	2.25E-06	7.93E-08	6.16E-07	4.83E-09	–
Benz[a]anthracene	–	–	–	–	–
Carbazole	5.04E-06	1.78E-07	1.38E-06	3.55E-09	–
Chrysene	1.05E-06	3.70E-08	2.88E-07	2.26E-10	–
Total CPAH:	1.06E-05			6.43E-08	–
Noncarcinogenic PAHs:					
Acenaphthene	7.75E-05	2.73E-06	2.12E-05	–	3.54E-04
Anthracene	8.68E-07	3.06E-08	2.38E-07	–	7.93E-07
Fluoranthene	7.38E-09	2.60E-10	2.02E-09	–	5.05E-08
Fluorene	1.76E-06	6.20E-08	4.82E-07	–	1.21E-05
Naphthalene	1.45E-04	5.11E-06	3.97E-05	–	9.93E-04
Phenanthrene	2.96E-06	1.04E-07	8.11E-07	–	2.03E-05
Pyrene	1.11E-06	3.91E-08	3.04E-07	–	1.01E-05
Total PAH:	2.40E-04			6.43E-08	1.39E-03
Pentachlorophenol	–	–	–	–	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				6.43E-08	1.39E-03

Southern Maryland Wood Treatment Site

Child resident ambient air inhalation.

Remedial alternative 9: risks from air emissions during bio-oxidation with activated sludge

Inhalation rate	*m3/d*	**12**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/m3*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	3.44E-08	2.26E-09	2.64E-08	1.38E-08	–
Benzo[b]fluoranthene	2.25E-06	1.48E-07	1.73E-06	9.02E-08	–
Benzo[k]fluoranthene	2.25E-06	1.48E-07	1.73E-06	9.02E-09	–
Benz[a]anthracene	–	–	–	–	–
Carbazole	5.04E-06	3.31E-07	3.87E-06	6.63E-09	–
Chrysene	1.05E-06	6.90E-08	8.05E-07	4.21E-10	–
Total CPAH:	1.06E-05			1.20E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	7.75E-05	5.10E-06	5.95E-05	–	9.91E-04
Anthracene	8.68E-07	5.71E-08	6.66E-07	–	2.22E-06
Fluoranthene	7.38E-09	4.85E-10	5.66E-09	–	1.42E-07
Fluorene	1.76E-06	1.16E-07	1.35E-06	–	3.38E-05
Naphthalene	1.45E-04	9.53E-06	1.11E-04	–	2.78E-03
Phenanthrene	2.96E-06	1.95E-07	2.27E-06	–	5.68E-05
Pyrene	1.11E-06	7.30E-08	8.52E-07	–	2.84E-05
Total PAH:	2.40E-04			1.20E-07	3.89E-03
Pentachlorophenol	–	–	–	–	–
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				1.20E-07	3.89E-03

Southern Maryland Wood Treatment Site

Construction worker soil ingestion

Remedial alternatives 1 and 2: Risk due to no-action alternative

Soil ingestion rate	*mg/d*	**480**
Exposure frequency	*d/y*	**250**
Exposure duration	*y*	**1**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**365**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.46E+01	2.99E-06	2.09E-04	2.18E-05	–
Benzo[b]fluoranthene	5.17E+01	3.47E-06	2.43E-04	2.53E-06	–
Benzo[k]fluoranthene	5.35E+01	3.59E-06	2.51E-04	2.62E-07	–
Benz[a]anthracene	1.05E+02	7.04E-06	4.93E-04	5.14E-06	–
Carbazole	3.43E+02	2.30E-05	1.61E-03	4.60E-07	–
Chrysene	1.50E+02	1.00E-05	7.03E-04	7.33E-08	–
Total CPAH:	7.47E+02			3.03E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	4.77E+02	3.20E-05	2.24E-03	–	3.73E-02
Anthracene	1.31E+03	8.80E-05	6.16E-03	–	2.05E-02
Fluoranthene	6.66E+02	4.47E-05	3.13E-03	–	7.82E-02
Fluorene	4.43E+02	2.97E-05	2.08E-03	–	5.20E-02
Naphthalene	5.16E+02	3.46E-05	2.42E-03	–	6.05E-02
Phenanthrene	1.14E+03	7.62E-05	5.33E-03	–	1.33E-01
Pyrene	4.43E+02	2.97E-05	2.08E-03	–	6.94E-02
Total PAH:	5.74E+03			3.03E-05	4.51E-01
Pentachlorophenol	5.66E+01	3.80E-06	2.66E-04	4.56E-07	8.87E-03
Volatile aromatics:					
Benzene	3.10E-02	2.08E-09	1.46E-07	6.03E-11	–
Ethylbenzene	3.40E+00	2.28E-07	1.60E-05	–	1.60E-04
Styrene	1.90E+00	1.27E-07	8.92E-06	–	4.46E-05
Xylene	5.90E+00	3.96E-07	2.77E-05	–	1.39E-05
Total:				3.07E-05	4.60E-01

Southern Maryland Wood Treatment Site

Construction worker soil ingestion

Remedial alternatives 5, 6, and 7: Risks based on 10 ppm CPAH in subsurface soil

Soil ingestion rate	*mg/d*	480
Exposure frequency	*d/y*	250
Exposure duration	*y*	1
Body weight	*kg*	70
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	365

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.96E-01	4.00E-08	2.80E-06	2.92E-07	–
Benzo[b]fluoranthene	6.92E-01	4.64E-08	3.25E-06	3.39E-08	–
Benzo[k]fluoranthene	7.17E-01	4.81E-08	3.37E-06	3.51E-09	–
Benz[a]anthracene	1.40E+00	9.42E-08	6.60E-06	6.88E-08	–
Carbazole	4.59E+00	3.08E-07	2.15E-05	6.16E-09	–
Chrysene	2.00E+00	1.34E-07	9.41E-06	9.81E-10	–
Total CPAH:	1.00E+01			4.05E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	6.38E+00	4.28E-07	3.00E-05	–	5.00E-04
Anthracene	1.76E+01	1.18E-06	8.25E-05	–	2.75E-04
Fluoranthene	8.92E+00	5.98E-07	4.19E-05	–	1.05E-03
Fluorene	5.93E+00	3.98E-07	2.79E-05	–	6.96E-04
Naphthalene	6.90E+00	4.63E-07	3.24E-05	–	8.10E-04
Phenanthrene	1.52E+01	1.02E-06	7.14E-05	–	1.78E-03
Pyrene	5.93E+00	3.98E-07	2.79E-05	–	9.29E-04
Total PAH:	7.68E+01			4.05E-07	6.04E-03
Pentachlorophenol	7.58E-01	5.09E-08	3.56E-06	6.10E-09	1.19E-04
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				4.12E-07	6.16E-03

Southern Maryland Wood Treatment Site

Construction worker soil ingestion
Remedial alternative 8: postremedial risk after 5 years of composting

Soil ingestion rate	*mg/d*	**480**
Exposure frequency	*d/y*	**250**
Exposure duration	*y*	**1**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**365**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)
Carcinogenic risk = LADD x Slope Factor
Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.68E+00	3.81E-07	2.67E-05	2.78E-06	–
Benzo[b]fluoranthene	6.59E+00	4.42E-07	3.10E-05	3.23E-07	–
Benzo[k]fluoranthene	6.83E+00	4.58E-07	3.21E-05	3.35E-08	–
Benz[a]anthracene	1.34E+01	8.98E-07	6.29E-05	6.56E-07	–
Carbazole	2.69E+00	1.81E-07	1.26E-05	3.61E-09	–
Chrysene	1.91E+01	1.28E-06	8.97E-05	9.35E-09	–
Total CPAH:	5.43E+01			3.81E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	2.13E-04	1.43E-11	9.98E-10	–	1.66E-08
Anthracene	5.33E+00	3.58E-07	2.51E-05	–	8.35E-05
Fluoranthene	8.50E+01	5.70E-06	3.99E-04	–	9.98E-03
Fluorene	5.74E-02	3.85E-09	2.70E-07	–	6.74E-06
Naphthalene	4.65E-05	3.12E-12	2.19E-10	–	5.46E-09
Phenanthrene	4.59E-02	3.08E-09	2.15E-07	–	5.39E-06
Pyrene	5.66E+01	3.80E-06	2.66E-04	–	8.86E-03
Total PAH:	2.01E+02			3.81E-06	1.89E-02
Pentachlorophenol	4.65E-02	3.12E-09	2.18E-07	3.74E-10	7.27E-06
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				3.81E-06	1.89E-02

Southern Maryland Wood Treatment Site

Construction worker soil ingestion

Remedial alternative 8: postremedial risk after 10 years of composting

Soil ingestion rate	*mg/d*	**480**
Exposure frequency	*d/y*	**250**
Exposure duration	*y*	**1**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**365**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	7.25E-01	4.87E-08	3.41E-06	3.55E-07	–
Benzo[b]fluoranthene	8.41E-01	5.64E-08	3.95E-06	4.12E-08	–
Benzo[k]fluoranthene	8.71E-01	5.85E-08	4.09E-06	4.27E-09	–
Benz[a]anthracene	1.71E+00	1.15E-07	8.02E-06	8.36E-08	–
Carbazole	2.12E-02	1.42E-09	9.93E-08	2.84E-11	–
Chrysene	2.44E+00	1.63E-07	1.14E-05	1.19E-09	–
Total CPAH:	6.60E+00			4.86E-07	–
Noncarcinogenic PAHs:					
Acenaphthene	9.47E-11	6.36E-18	4.45E-16	–	7.42E-15
Anthracene	2.17E-02	1.46E-09	1.02E-07	–	3.40E-07
Fluoranthene	1.08E+01	7.28E-07	5.09E-05	–	1.27E-03
Fluorene	7.45E-06	5.00E-13	3.50E-11	–	8.74E-10
Naphthalene	4.20E-12	2.82E-19	1.97E-17	–	4.93E-16
Phenanthrene	1.85E-06	1.24E-13	8.70E-12	–	2.18E-10
Pyrene	7.22E+00	4.84E-07	3.39E-05	–	1.13E-03
Total PAH:	2.47E+01			4.86E-07	2.40E-03
Pentachlorophenol	3.81E-05	2.56E-12	1.79E-10	3.07E-13	5.97E-09
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				4.86E-07	2.40E-03

Southern Maryland Wood Treatment Site

Construction worker soil ingestion

Remedial alternative 9: Postremedial risk after bioxidation w/ activated sludge process

Soil ingestion rate	*mg/d*	**480**
Exposure frequency	*d/y*	**250**
Exposure duration	*y*	**1**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**365**

Daily Dose (LADD or CDD) = (RME Conc. x IR x 1E-6 kg/mg x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/kg*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	2.23E+00	1.49E-07	1.05E-05	1.09E-06	–
Benzo[b]fluoranthene	2.58E+00	1.73E-07	1.21E-05	1.27E-07	–
Benzo[k]fluoranthene	2.68E+00	1.80E-07	1.26E-05	1.31E-08	–
Benz[a]anthracene	5.25E+00	3.52E-07	2.46E-05	2.57E-07	–
Carbazole	1.71E+01	1.15E-06	8.05E-05	2.30E-08	–
Chrysene	7.48E+00	5.02E-07	3.51E-05	3.66E-09	–
Total CPAH:	3.74E+01			1.51E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	2.39E+01	1.60E-06	1.12E-04	–	1.87E-03
Anthracene	6.56E+01	4.40E-06	3.08E-04	–	1.03E-03
Fluoranthene	3.33E+01	2.24E-06	1.56E-04	–	3.91E-03
Fluorene	2.22E+01	1.49E-06	1.04E-04	–	2.60E-03
Naphthalene	2.58E+01	1.73E-06	1.21E-04	–	3.03E-03
Phenanthrene	5.68E+01	3.81E-06	2.67E-04	–	6.67E-03
Pyrene	2.22E+01	1.49E-06	1.04E-04	–	3.47E-03
Total PAH:	2.87E+02			1.51E-06	2.26E-02
Pentachlorophenol	2.83E+00	1.90E-07	1.33E-05	2.28E-08	4.43E-04
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				1.54E-06	2.30E-02

Southern Maryland Wood Treatment Site

Resident adult groundwater ingestion

Remedial alternatives 6&7, assuming 10 mg/kg CPAH remain in subsurface soil

Drinking water ingestion	*L/d*	**2**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.20E-05	3.95E-07	1.15E-06	2.88E-06	–
Benzo[b]fluoranthene	8.00E-06	7.51E-08	2.19E-07	5.49E-08	–
Benzo[k]fluoranthene	2.00E-06	1.88E-08	5.48E-08	1.37E-09	–
Benz[a]anthracene	5.14E-04	4.83E-06	1.41E-05	3.52E-06	–
Carbazole	2.44E-01	2.29E-03	6.68E-03	4.58E-05	–
Chrysene	1.21E-03	1.14E-05	3.32E-05	8.30E-08	–
Total CPAH:	2.46E-01			5.24E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.16E-01	2.03E-03	5.92E-03	–	9.86E-02
Anthracene	1.75E-01	1.64E-03	4.79E-03	–	1.60E-02
Fluoranthene	3.15E-02	2.96E-04	8.63E-04	–	2.16E-02
Fluorene	1.10E-01	1.03E-03	3.01E-03	–	7.53E-02
Naphthalene	9.97E-01	9.37E-03	2.73E-02	–	6.83E-01
Phenanthrene	1.48E-01	1.39E-03	4.05E-03	–	1.01E-01
Pyrene	2.20E-02	2.07E-04	6.03E-04	–	2.01E-02
Total PAH:	1.95E+00			5.24E-05	1.02E+00
Pentachlorophenol	2.48E-03	2.33E-05	6.79E-05	2.80E-06	2.26E-03
Volatile aromatics:					
Benzene	8.30E-04	7.80E-06	2.27E-05	2.26E-07	–
Ethylbenzene	9.10E-03	8.55E-05	2.49E-04	–	2.49E-03
Styrene	4.72E-03	4.43E-05	1.29E-04	–	6.47E-04
Xylene	5.13E-02	4.82E-04	1.41E-03	–	7.03E-04
Total:				5.54E-05	1.02E+00

Southern Maryland Wood Treatment Site

Resident child groundwater ingestion

Remedial alternatives 6&7, assuming 10 mg/kg CPAH remain in subsurface soil

Drinking water ingestion	*L/d*	1
Exposure frequency	*d/y*	350
Exposure duration	*y*	6
Body weight	*kg*	15
Averaging time carc.	*d*	25550
Averaging time ncarc.	*d*	2190

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.20E-05	2.30E-07	2.68E-06	1.68E-06	–
Benzo[b]fluoranthene	8.00E-06	4.38E-08	5.11E-07	3.20E-08	–
Benzo[k]fluoranthene	2.00E-06	1.10E-08	1.28E-07	8.00E-10	–
Benz[a]anthracene	5.14E-04	2.82E-06	3.29E-05	2.06E-06	–
Carbazole	2.44E-01	1.34E-03	1.56E-02	2.67E-05	–
Chrysene	1.21E-03	6.63E-06	7.74E-05	4.84E-08	–
Total CPAH:	2.46E-01			3.06E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	2.16E-01	1.18E-03	1.38E-02	–	2.30E-01
Anthracene	1.75E-01	9.59E-04	1.12E-02	–	3.73E-02
Fluoranthene	3.15E-02	1.73E-04	2.01E-03	–	5.03E-02
Fluorene	1.10E-01	6.03E-04	7.03E-03	–	1.76E-01
Naphthalene	9.97E-01	5.46E-03	6.37E-02	–	1.59E+00
Phenanthrene	1.48E-01	8.11E-04	9.46E-03	–	2.37E-01
Pyrene	2.20E-02	1.21E-04	1.41E-03	–	4.69E-02
Total PAH:	1.95E+00			3.06E-05	2.37E+00
Pentachlorophenol	2.48E-03	1.36E-05	1.59E-04	1.63E-06	5.28E-03
Volatile aromatics:					
Benzene	8.30E-04	4.55E-06	5.31E-05	1.32E-07	–
Ethylbenzene	9.10E-03	4.99E-05	5.82E-04	–	5.82E-03
Styrene	4.72E-03	2.59E-05	3.02E-04	–	1.51E-03
Xylene	5.13E-02	2.81E-04	3.28E-03	–	1.64E-03
Total:				3.23E-05	2.38E+00

Southern Maryland Wood Treatment Site

Resident adult groundwater ingestion

Remedial alternative 8: risks associated with groundwater quality after 5 years of composting

Drinking water ingestion	*L/d*	**2**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.04E-04	3.79E-06	1.11E-05	2.77E-05	–
Benzo[b]fluoranthene	7.80E-05	7.33E-07	2.14E-06	5.35E-07	–
Benzo[k]fluoranthene	2.40E-05	2.25E-07	6.58E-07	1.65E-08	–
Benz[a]anthracene	4.89E-03	4.59E-05	1.34E-04	3.35E-05	–
Carbazole	1.43E-01	1.34E-03	3.92E-03	2.69E-05	–
Chrysene	1.15E-02	1.08E-04	3.15E-04	7.89E-07	–
Total CPAH:	1.60E-01			8.94E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	7.00E-06	6.58E-08	1.92E-07	–	3.20E-06
Anthracene	5.32E-02	5.00E-04	1.46E-03	–	4.86E-03
Fluoranthene	3.01E-01	2.83E-03	8.25E-03	–	2.06E-01
Fluorene	1.07E-03	1.01E-05	2.93E-05	–	7.33E-04
Naphthalene	7.00E-06	6.58E-08	1.92E-07	–	4.79E-06
Phenanthrene	4.47E-04	4.20E-06	1.22E-05	–	3.06E-04
Pyrene	2.10E-01	1.97E-03	5.75E-03	–	1.92E-01
Total PAH:	7.26E-01			8.94E-05	4.04E-01
Pentachlorophenol	1.52E-04	1.43E-06	4.16E-06	1.71E-07	1.39E-04
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				8.96E-05	4.04E-01

Southern Maryland Wood Treatment Site

Resident child groundwater ingestion

Remedial alternative 8: risks associated with groundwater quality after 5 years of composting

Drinking water ingestion	*L/d*	**1**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	4.04E-04	2.21E-06	2.58E-05	1.62E-05	–
Benzo[b]fluoranthene	7.80E-05	4.27E-07	4.99E-06	3.12E-07	–
Benzo[k]fluoranthene	2.40E-05	1.32E-07	1.53E-06	9.60E-09	–
Benz[a]anthracene	4.89E-03	2.68E-05	3.13E-04	1.96E-05	–
Carbazole	1.43E-01	7.84E-04	9.14E-03	1.57E-05	–
Chrysene	1.15E-02	6.30E-05	7.35E-04	4.60E-07	–
Total CPAH:	1.60E-01			5.22E-05	–
Noncarcinogenic PAHs:					
Acenaphthene	7.00E-06	3.84E-08	4.47E-07	–	7.46E-06
Anthracene	5.32E-02	2.92E-04	3.40E-03	–	1.13E-02
Fluoranthene	3.01E-01	1.65E-03	1.92E-02	–	4.81E-01
Fluorene	1.07E-03	5.86E-06	6.84E-05	–	1.71E-03
Naphthalene	7.00E-06	3.84E-08	4.47E-07	–	1.12E-05
Phenanthrene	4.47E-04	2.45E-06	2.86E-05	–	7.14E-04
Pyrene	2.10E-01	1.15E-03	1.34E-02	–	4.47E-01
Total PAH:	7.26E-01			5.22E-05	9.42E-01
Pentachlorophenol	1.52E-04	8.33E-07	9.72E-06	9.99E-08	3.24E-04
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				5.23E-05	9.43E-01

Southern Maryland Wood Treatment Site

Resident adult groundwater ingestion

Remedial alternative 8: risks associated with groundwater quality after 10 years of composting

Drinking water ingestion	*L/d*	**2**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	RME Conc. mg/L	Lifetime Average Daily Dose mg/kg/d	Chronic Daily Dose mg/kg/d	Lifetime Cancer Risk	Systemic Hazard Quotient
Carcinogenic PAHs:					
Benzo[a]pyrene	5.15E-05	4.84E-07	1.41E-06	3.53E-06	–
Benzo[b]fluoranthene	1.00E-05	9.39E-08	2.74E-07	6.86E-08	–
Benzo[k]fluoranthene	3.00E-06	2.82E-08	8.22E-08	2.06E-09	–
Benz[a]anthracene	6.25E-04	5.87E-06	1.71E-05	4.29E-06	–
Carbazole	1.12E-03	1.05E-05	3.07E-05	2.10E-07	–
Chrysene	1.47E-03	1.38E-05	4.03E-05	1.01E-07	–
Total CPAH:	3.28E-03			8.20E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	–	–	–	–	–
Anthracene	2.16E-04	2.03E-06	5.92E-06	–	1.97E-05
Fluoranthene	3.84E-02	3.61E-04	1.05E-03	–	2.63E-02
Fluorene	1.00E-07	9.39E-10	2.74E-09	–	6.85E-08
Naphthalene	–	–	–	–	–
Phenanthrene	–	–	–	–	–
Pyrene	2.67E-02	2.51E-04	7.32E-04	–	2.44E-02
Total PAH:	6.86E-02			8.20E-06	5.07E-02
Pentachlorophenol	1.00E-07	9.39E-10	2.74E-09	1.13E-10	9.13E-08
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				8.20E-06	5.07E-02

Southern Maryland Wood Treatment Site

Resident child groundwater ingestion

Remedial alternative 8: risks associated with groundwater quality after 10 years of composting

Drinking water ingestion	*L/d*	**1**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	5.15E-05	2.82E-07	3.29E-06	2.06E-06	–
Benzo[b]fluoranthene	1.00E-05	5.48E-08	6.39E-07	4.00E-08	–
Benzo[k]fluoranthene	3.00E-06	1.64E-08	1.92E-07	1.20E-09	–
Benz[a]anthracene	6.25E-04	3.42E-06	4.00E-05	2.50E-06	–
Carbazole	1.12E-03	6.14E-06	7.16E-05	1.23E-07	–
Chrysene	1.47E-03	8.05E-06	9.40E-05	5.88E-08	–
Total CPAH:	3.28E-03			4.78E-06	–
Noncarcinogenic PAHs:					
Acenaphthene	–	–	–	–	–
Anthracene	2.16E-04	1.18E-06	1.38E-05	–	4.60E-05
Fluoranthene	3.84E-02	2.10E-04	2.45E-03	–	6.14E-02
Fluorene	1.00E-07	5.48E-10	6.39E-09	–	1.60E-07
Naphthalene	–	–	–	–	–
Phenanthrene	–	–	–	–	–
Pyrene	2.67E-02	1.46E-04	1.71E-03	–	5.69E-02
Total PAH:	6.86E-02			4.78E-06	1.18E-01
Pentachlorophenol	1.00E-07	5.48E-10	6.39E-09	6.58E-11	2.13E-07
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				4.78E-06	1.18E-01

Southern Maryland Wood Treatment Site

Resident adult groundwater ingestion

Remedial alternative 9: risks from groundwater quality after bioxidation w/ activated sludge process

Drinking water ingestion	*L/d*	**2**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**24**
Body weight	*kg*	**70**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**8760**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.58E-04	1.48E-06	4.33E-06	1.08E-05	–
Benzo[b]fluoranthene	3.08E-05	2.89E-07	8.44E-07	2.11E-07	–
Benzo[k]fluoranthene	9.20E-06	8.64E-08	2.52E-07	6.31E-09	–
Benz[a]anthracene	1.92E-03	1.80E-05	5.26E-05	1.32E-05	–
Carbazole	9.10E-01	8.55E-03	2.49E-02	1.71E-04	–
Chrysene	4.52E-03	4.25E-05	1.24E-04	3.10E-07	–
Total CPAH:	9.17E-01			1.95E-04	–
Noncarcinogenic PAHs:					
Acenaphthene	8.06E-01	7.57E-03	2.21E-02	–	3.68E-01
Anthracene	6.54E-02	6.14E-04	1.79E-03	–	5.97E-03
Fluoranthene	1.18E-01	1.11E-03	3.23E-03	–	8.08E-02
Fluorene	4.12E-01	3.87E-03	1.13E-02	–	2.82E-01
Naphthalene	3.72E+00	3.49E-02	1.02E-01	–	2.55E+00
Phenanthrene	5.53E-01	5.19E-03	1.52E-02	–	3.79E-01
Pyrene	8.21E-02	7.71E-04	2.25E-03	–	7.50E-02
Total PAH:	6.67E+00			1.95E-04	3.74E+00
Pentachlorophenol	9.26E-03	8.70E-05	2.54E-04	1.04E-05	8.46E-03
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				2.06E-04	3.75E+00

Southern Maryland Wood Treatment Site

Resident child groundwater ingestion

Remedial alternative 9: risks from groundwater quality after bioxidation w/ activated sludge process

Drinking water ingestion	*L/d*	**1**
Exposure frequency	*d/y*	**350**
Exposure duration	*y*	**6**
Body weight	*kg*	**15**
Averaging time carc.	*d*	**25550**
Averaging time ncarc.	*d*	**2190**

Daily Dose (LADD or CDD) = (RME Conc. x IR x EF x ED) / (BW x AT)

Carcinogenic risk = LADD x Slope Factor

Hazard Quotient = CDD / Reference Dose

Contaminant	*RME Conc. mg/L*	*Lifetime Average Daily Dose mg/kg/d*	*Chronic Daily Dose mg/kg/d*	*Lifetime Cancer Risk*	*Systemic Hazard Quotient*
Carcinogenic PAHs:					
Benzo[a]pyrene	1.58E-04	8.66E-07	1.01E-05	6.32E-06	–
Benzo[b]fluoranthene	3.08E-05	1.69E-07	1.97E-06	1.23E-07	–
Benzo[k]fluoranthene	9.20E-06	5.04E-08	5.88E-07	3.68E-09	–
Benz[a]anthracene	1.92E-03	1.05E-05	1.23E-04	7.68E-06	–
Carbazole	9.10E-01	4.99E-03	5.82E-02	9.97E-05	–
Chrysene	4.52E-03	2.48E-05	2.89E-04	1.81E-07	–
Total CPAH:	9.17E-01			1.14E-04	–
Noncarcinogenic PAHs:					
Acenaphthene	8.06E-01	4.42E-03	5.15E-02	–	8.59E-01
Anthracene	6.54E-02	3.58E-04	4.18E-03	–	1.39E-02
Fluoranthene	1.18E-01	6.47E-04	7.54E-03	–	1.89E-01
Fluorene	4.12E-01	2.26E-03	2.63E-02	–	6.58E-01
Naphthalene	3.72E+00	2.04E-02	2.38E-01	–	5.95E+00
Phenanthrene	5.53E-01	3.03E-03	3.54E-02	–	8.84E-01
Pyrene	8.21E-02	4.50E-04	5.25E-03	–	1.75E-01
Total PAH:	6.67E+00			1.14E-04	8.72E+00
Pentachlorophenol	9.26E-03	5.07E-05	5.92E-04	6.09E-06	1.97E-02
Volatile aromatics:					
Benzene	–	–	–	–	–
Ethylbenzene	–	–	–	–	–
Styrene	–	–	–	–	–
Xylene	–	–	–	–	–
Total:				1.20E-04	8.74E+00

Southern Maryland Wood Treatment Site

Summary table of soil cleanup levels, by remedial alternative.

Remedial alternatives 3, 4, and 5, which involve capping and removal, should result in surface soil concentrations equal to background. Because background concentrations will be associated with the same risks as in uncontaminated areas, they have been omitted from the risk calculations, effectively treating background concentrations as zero.

	Remedial alternatives:					
Contaminant	1&2	6&7 Surface	6&7 Subsurface	8 (5 years)	8 (10 years)	9
Carcinogenic PAHs:						
Benzo[a]pyrene	44.562642	0.0596455	0.5964552	5.6848752	0.7252219	2.2281321
Benzo[b]fluoranthene	51.671301	0.0691602	0.6916021	6.5917297	0.8409098	2.583565
Benzo[k]fluoranthene	53.543256	0.0716658	0.7166575	6.8305359	0.8713744	2.6771628
Benz[a]anthracene	104.92401	0.1404371	1.4043707	13.3852	1.7075557	5.2462004
Carbazole	342.79545	0.4588196	4.5881959	2.6927852	0.0211528	17.139773
Chrysene	149.62805	0.2002719	2.0027185	19.088114	2.4350788	7.4814026
Total CPAH:	747.12471	1	10	54.27324	6.6012934	37.356236
Noncarcinogenic PAHs:						
Acenaphthene	477.03592	0.6384957	6.3849571	0.0002126	9.47E-11	23.851796
Anthracene	1311.6393	1.7555829	17.555829	5.3341403	0.0216927	65.581967
Fluoranthene	666.29604	0.8918137	8.9181368	84.999668	10.843444	33.314802
Fluorene	443.07815	0.5930444	5.9304443	0.0574421	7.45E-06	22.153908
Naphthalene	515.57767	0.6900825	6.9008248	0.0000465	4.20E-12	25.778884
Phenanthrene	1135.4219	1.519722	15.19722	0.0458638	1.85E-06	56.771095
Pyrene	443.38226	0.5934515	5.9345147	56.562463	7.2156974	22.169113
Total PAH:	5739.556	7.6821927	76.821927	201.27308	24.682137	286.9778
Pentachlorophenol	56.636275	0.0758057	0.7580565	0.0464536	0.0000381	2.8318138
Volatile aromatics:						
Benzene	0.0310	–	–	–	–	–
Ethylbenzene	3.4000	–	–	–	–	–
Styrene	1.9000	–	–	–	–	–
Xylene	5.9000	–	–	–	–	–

Southern Maryland Wood Treatment Site

Summary risk matrix: upper bound excess lifetime cancer risk

"--" : Exposure route not assessed

Remedial Alternative	Air	Soil	Groundwater	Total
	Risk to Residents			
1,2: No action, limited action	2.01E-07	7.17E-04	–	–
3: Capping and containment	1.44E-07	–	–	–
4: Excavation, capping, and containment	7.00E-07	–	–	–
5: Excavation and off-site disposal	2.42E-07	–	–	–
6: Thermal treatment	1.99E-07	9.60E-07	8.77E-05	8.89E-05
7: Thermal desorption	2.20E-06	9.60E-07	8.77E-05	9.09E-05
8: Excavation and on-site bioremediation (5 y)	1.33E-05	8.89E-05	1.42E-04	2.44E-04
8: Excavation and on-site bioremediation (10 y	1.33E-05	1.13E-05	1.30E-05	3.76E-05
9: Bio-slurry	3.81E-07	3.59E-05	3.26E-04	3.62E-04
	Risk to Workers			
1,2: No action, limited action	–	3.07E-05	–	
3: Capping and containment	–	–	–	
4: Excavation, capping, and containment	–	–	–	
5: Excavation and off-site disposal	–	4.12E-07	–	
6: Thermal treatment	–	4.12E-07	–	
7: Thermal desorption	–	4.12E-07	–	
8: Excavation and on-site bioremediation (5 y)	–	3.81E-06	–	
8: Excavation and on-site bioremediation (10 y	–	4.86E-07	–	
9: Bio-slurry	–	1.54E-06	–	

Southern Maryland Wood Treatment Site

Summary risk matrix: non-cancer hazard index

"--" : Exposure route not assessed

Remedial Alternative	Air	Soil	Groundwater	Total
	Risk to Residents			
1,2: No action, limited action	0.1472	1.2536	--	--
3: Capping and containment	0.1472	--	--	--
4: Excavation, capping, and containment	0.0447	--	--	--
5: Excavation and off-site disposal	0.0431	--	--	--
6: Thermal treatment	0.0429	0.0017	2.3846	2.4292
7: Thermal desorption	0.0429	0.0017	2.3846	2.4292
8: Excavation and on-site bioremediation (5 y)	0.0429	0.0516	0.9426	1.0371
8: Excavation and on-site bioremediation (10 y	0.0429	0.0065	0.1183	0.1678
9: Bio-slurry	0.0429	0.0626	8.7434	8.8489
	Risk to Workers			
1,2: No action, limited action	--	0.4605	--	
3: Capping and containment	--	--	--	
4: Excavation, capping, and containment	--	--	--	
5: Excavation and off-site disposal	--	0.0062	--	
6: Thermal treatment	--	0.0062	--	
7: Thermal desorption	--	0.0062	--	
8: Excavation and on-site bioremediation (5 y)	--	0.0189	--	
8: Excavation and on-site bioremediation (10 y	--	0.0024	--	
9: Bio-slurry	--	0.0230	--	

APPENDIX 1: ESTIMATES OF CONTAMINANT CONCENTRATIONS IN AIR DURING AND AFTER REMEDIATION: SOUTHERN MARYLAND WOOD TREATMENT SITE

PATRICIA FLORES
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 3
AIR, RADIATION AND TOXICS DIVISION

October 15, 1994

Southern Maryland Woodtreatment Site

Site assumptions:

1. Moisture content of soil = 20%
2. Silt content of soil = 25%
3. Vegetation = 20%
4. Area of site = 25 acres = 101,175 m^2
5. Uniform distribution of contaminants
6. No crust present
7. Aggregate size distribution = 0.15 mm
8. Mean annual windspeed = 6 knots = 3.08 m/s
9. Naphthalene behaves as a weak VOC as well as a semi-volatile
10. Mean truck weight = 20 Mg
11. Mean truck speed = 20 km/hr
12. Mean truck number of wheels = 10
13. Silt loading on paved roads = 5 g/m^2
14. Annual average concentrations were calculated for a receptor at the fenceline and a receptor located 50 meters away from the site

15. The compounds listed below were assumed to be on-site. These data were gleaned from the document *Focused Feasibility Study, Southern Maryland Woodtreating Site, January 1994 - Appendix A, February 1994*. The data are probably not representative of the actual contamination in the site. The VOC data were taken from one sample (B-1, 0-2ft), and the maximum concentrations of semi-volatiles found in Table 11 - "Soil Boring Results - Surface Samples, April 1993" were also used. There may be additional compounds of concern, or more representative concentrations. Because of this, for all calculations I have included an annual average concentration normalized to the pollutant concentration in ppm.

    If any additional VOCs are suspected unswayed, I will need to perform additional calculations since the emission estimation model for VOCs in the "No Action" scenario are based on the individual compound physical properties. The emission estimation models for semi-volatiles, metals, and the other scenarios are based on mechanical processes. Therefore, for these compounds, all that is necessary is the concentration of the additional compounds in ppm.

16. All of the air dispersion models that were used were screening models. Due to the uncertainty in the site data and certain air emission estimation models, the use of refined air dispersion models was not prudent.

Compounds Found on the Southern Maryland Woodtreatment Superfund Site

From *Focused Feasibility Study, Southern Maryland Woodtreating Site, January 1994 - Appendix A, February 1994*

Compound	Maximum Concentration mg/Kg or ppm
Volatile Organic Compounds	
benzene	0.031
ethylbenzene	3.4
styrene	1.9
xylene	5.9
Semi-Volatile Organic Compounds	
naphthalene	84.3
acenaphthene	140
fluorene	100
pentachlorophenol	180
phenanthrene	250
anthracene	230
carbazole	60
fluoranthene	430
pyrene	390
benzo(a)anthracene	72
chrysene	110
benzo(b)fluoranthene	52.6
benzo(k)fluoranthene	48.2
benzo(a)pyrene	43.5

Remediation Scenarios

1. No Action Scenario

   Assumptions:

   a. Site will remain "as is" for at least 30 years.
   b. Volatilization accounts for all air emissions of VOCs.
   c. Erosion accounts for all air emissions of semi-volatiles, etc. Cowherd's "unlimited reservoir" model is applicable.

fenceline

Compound	Max. Conc. (ppm)	Annual Avg. Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.031	1.012
ethylbenzene	3.4	1.037	3.121×10^{-1}
styrene	1.9	0.310	1.634×10^{-1}
xylene	5.9	1.294	2.193×10^{-1}
naphthalene	84.3	6.501	7.712×10^{-2}
Semi-Volatile Organic Compounds			
naphthalene	84.3	8.242×10^{-5}	9.778×10^{-7}
acenaphthene	140	1.369×10^{-4}	9.778×10^{-7}
fluorene	100	9.778×10^{-5}	9.778×10^{-7}
pentachlorophenol	180	1.760×10^{-4}	9.778×10^{-7}
phenanthrene	250	2.444×10^{-4}	9.778×10^{-7}
anthracene	230	2.249×10^{-4}	9.778×10^{-7}
carbazole	60	5.867×10^{-5}	9.778×10^{-7}
fluoranthene	430	4.204×10^{-4}	9.778×10^{-7}
pyrene	390	3.813×10^{-4}	9.778×10^{-7}
benzo(a)anthracene	72	7.040×10^{-5}	9.778×10^{-7}
chrysene	110	1.076×10^{-4}	9.778×10^{-7}
benzo(b)fluoranthene	52.6	5.143×10^{-5}	9.778×10^{-7}
benzo(k)fluoranthene	48.2	4.713×10^{-5}	9.778×10^{-7}
benzo(a)pyrene	43.5	4.253×10^{-5}	9.778×10^{-7}

1. No Action Scenario (continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Avg. Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.003	8.446×10^{-2}
ethylbenzene	3.4	0.087	2.559×10^{-2}
styrene	1.9	0.026	1.368×10^{-2}
xylene	5.9	0.108	1.831×10^{-2}
naphthalene	84.3	0.545	6.465×10^{-3}
Semi-Volatile Organic Compounds			
naphthalene	84.3	1.148×10^{-5}	8.198×10^{-8}
acenaphthene	140	6.911×10^{-5}	8.198×10^{-8}
fluorene	100	8.198×10^{-6}	8.198×10^{-8}
pentachlorophenol	180	1.476×10^{-5}	8.198×10^{-8}
phenanthrene	250	2.050×10^{-5}	8.198×10^{-8}
anthracene	230	1.886×10^{-5}	8.198×10^{-8}
carbazole	60	4.919×10^{-6}	8.198×10^{-8}
fluoranthene	430	3.525×10^{-5}	8.198×10^{-8}
pyrene	390	3.197×10^{-5}	8.198×10^{-8}
benzo(a)anthracene	72	5.903×10^{-6}	8.198×10^{-8}
chrysene	110	9.018×10^{-6}	8.198×10^{-8}
benzo(b)fluoranthene	52.6	4.312×10^{-6}	8.198×10^{-8}
benzo(k)fluoranthene	48.2	3.951×10^{-6}	8.198×10^{-8}
benzo(a)pyrene	43.5	3.566×10^{-6}	8.198×10^{-8}

2. Cap Entire Site

Assumptions:

a. Since the cap will incorporate a passive gas venting system, the VOC emissions will be the same as the "No Action" scenario.
b. There will be no particulate emissions and thus no semi-volatile emissions due to the cap.

fenceline

Compound	Max. Conc. (ppm)	Annual Avg. Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.031	1.012
ethylbenzene	3.4	1.037	3.121×10^{-1}
styrene	1.9	0.310	1.634×10^{-1}
xylene	5.9	1.294	2.193×10^{-1}
naphthalene	84.3	6.501	7.712×10^{-2}

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Aver. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.003	8.446×10^{-2}
ethylbenzene	3.4	0.087	2.559×10^{-2}
styrene	1.9	0.026	1.368×10^{-2}
xylene	5.9	0.108	1.831×10^{-2}
naphthalene	84.3	0.545	6.465×10^{-3}

3. Excavate, Confine in 5 Acres, and Cap

Assumptions:

a. Due to excavation and material handling activities, all of the VOCs (except naphthalene) will volatilize from the soil in the two years.
b. Particulate emissions were estimated for excavation of soil, adding the soil to a truck, trucking the soil on the unpaved contaminated site soil (7,500 trips, 800 feet average roundtrip per truck), removing the soil from the truck, and grading the soil using a bulldozer.
c. Once the cap is in place, there will be no particulate emissions and thus no semi-volatile emissions.

3. Excavate, Confine in 5 Acres, and Cap (continued)

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.026	0.830
ethylbenzene	3.4	2.823	0.830
styrene	1.9	1.577	0.830
xylene	5.9	4.898	0.830
Semi-Volatile Organic Compounds			
PM_{10}	——	84.75	——
naphthalene	84.3	7.150×10^{-3}	8.482×10^{-5}
acenaphthene	140	1.187×10^{-2}	8.482×10^{-5}
fluorene	100	8.482×10^{-3}	8.482×10^{-5}
pentachlorophenol	180	1.527×10^{-2}	8.482×10^{-5}
phenanthrene	250	2.120×10^{-2}	8.482×10^{-5}
anthracene	230	1.951×10^{-2}	8.482×10^{-5}
carbazole	60	5.089×10^{-3}	8.482×10^{-5}
fluoranthene	430	3.647×10^{-2}	8.482×10^{-5}
pyrene	390	3.308×10^{-2}	8.482×10^{-5}
benzo(a)anthracene	72	6.107×10^{-3}	8.482×10^{-5}
chrysene	110	9.330×10^{-3}	8.482×10^{-5}
benzo(b)fluoranthene	52.6	4.462×10^{-3}	8.482×10^{-5}
benzo(k)fluoranthene	48.2	4.088×10^{-3}	8.482×10^{-5}
benzo(a)pyrene	43.5	3.690×10^{-3}	8.482×10^{-5}

3. Excavate, Confine in 5 Acres, and Cap (continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.002	6.962×10^{-2}
ethylbenzene	3.4	0.237	6.962×10^{-2}
styrene	1.9	0.132	6.962×10^{-2}
xylene	5.9	0.411	6.962×10^{-2}
Semi-Volatile Organic Compounds			
PM_{10}	———	7.107	———
naphthalene	84.3	5.996×10^{-4}	7.113×10^{-6}
acenaphthene	140	9.958×10^{-4}	7.113×10^{-6}
fluorene	100	7.113×10^{-4}	7.113×10^{-6}
pentachlorophenol	180	1.281×10^{-3}	7.113×10^{-6}
phenanthrene	250	1.778×10^{-3}	7.113×10^{-6}
anthracene	230	1.636×10^{-3}	7.113×10^{-6}
carbazole	60	4.268×10^{-4}	7.113×10^{-6}
fluoranthene	430	3.058×10^{-3}	7.113×10^{-6}
pyrene	390	2.774×10^{-3}	7.113×10^{-6}
benzo(a)anthracene	72	5.121×10^{-4}	7.113×10^{-6}
chrysene	110	7.824×10^{-4}	7.113×10^{-6}
benzo(b)fluoranthene	52.6	3.741×10^{-4}	7.113×10^{-6}
benzo(k)fluoranthene	48.2	3.428×10^{-4}	7.113×10^{-6}
benzo(a)pyrene	43.5	3.094×10^{-4}	7.113×10^{-6}

4. Excavate/Remediate Elsewhere

Assumptions:

a. Due to excavation and material handling activities, all of the VOCs (except naphthalene) will volatilize from the soil in the two years.
b. Contaminant particulate emissions were estimated for excavation of soil, adding the soil to a truck, and trucking the soil on the unpaved contaminated site soil (7,500 trips, 800 feet average roundtrip per truck).
c. In addition to (b) PM_{10} emissions were calculated for the 7500 trucks through 2 km of paved town roads. Contaminants are not assumed to exist on the paved town roads.
d. Whatever contaminants that remain can be calculated using the normalized annual average contaminant concentrations in the "No Action" scenario.

4. Excavate/Remediate Elsewhere (continued)

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.026	0.830
ethylbenzene	3.4	2.823	0.830
styrene	1.9	1.577	0.830
xylene	5.9	4.898	0.830
Semi-Volatile Organic Compounds			
PM_{10}	———	57.56	———
naphthalene	84.3	3.568×10^{-3}	2.793×10^{-5}
acenaphthene	140	3.909×10^{-3}	2.793×10^{-5}
fluorene	100	2.793×10^{-3}	2.793×10^{-5}
pentachlorophenol	180	5.028×10^{-3}	2.793×10^{-5}
phenanthrene	250	6.981×10^{-3}	2.793×10^{-5}
anthracene	230	6.423×10^{-3}	2.793×10^{-5}
carbazole	60	1.676×10^{-3}	2.793×10^{-5}
fluoranthene	430	1.201×10^{-2}	2.793×10^{-5}
pyrene	390	1.089×10^{-2}	2.793×10^{-5}
benzo(a)anthracene	72	2.011×10^{-3}	2.793×10^{-5}
chrysene	110	3.072×10^{-3}	2.793×10^{-5}
benzo(b)fluoranthene	52.6	1.469×10^{-3}	2.793×10^{-5}
benzo(k)fluoranthene	48.2	1.346×10^{-3}	2.793×10^{-5}
benzo(a)pyrene	43.5	1.215×10^{-3}	2.793×10^{-5}

4. Excavate/Remediate Elsewhere (continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.002	6.962×10^{-2}
ethylbenzene	3.4	0.237	6.962×10^{-2}
styrene	1.9	0.132	6.962×10^{-2}
xylene	5.9	0.411	6.962×10^{-2}
Semi-Volatile Organic Compounds			
PM_{10}	——	4.826	——
naphthalene	84.3	1.974×10^{-4}	2.342×10^{-6}
acenaphthene	140	3.278×10^{-4}	2.342×10^{-6}
fluorene	100	2.342×10^{-4}	2.342×10^{-6}
pentachlorophenol	180	4.215×10^{-4}	2.342×10^{-6}
phenanthrene	250	5.854×10^{-4}	2.342×10^{-6}
anthracene	230	5.386×10^{-4}	2.342×10^{-6}
carbazole	60	1.405×10^{-4}	2.342×10^{-6}
fluoranthene	430	1.007×10^{-3}	2.342×10^{-6}
pyrene	390	9.133×10^{-4}	2.342×10^{-6}
benzo(a)anthracene	72	1.686×10^{-4}	2.342×10^{-6}
chrysene	110	2.576×10^{-4}	2.342×10^{-6}
benzo(b)fluoranthene	52.6	1.232×10^{-4}	2.342×10^{-6}
benzo(k)fluoranthene	48.2	1.129×10^{-4}	2.342×10^{-6}
benzo(a)pyrene	43.5	1.072×10^{-4}	2.342×10^{-6}

5. Excavate/Unswayed Thermal Treatment (Excavation only)

Assumptions:

a. Due to excavation and material handling activities, all of the VOCs (except naphthalene) will volatilize from the soil in the two years.
b. Contaminant particulate emissions were estimated for excavation of soil, adding the soil to a truck, trucking the soil on the unpaved contaminated site soil (7,500 trips, 800 feet average roundtrip per truck) and dumping the soil at the thermal desorption unit.
c. Emissions from residual material - use normalized annual average contaminant concentrations from the "No Action" scenario.

5. Excavate/Unswayed Thermal Treatment (Excavation only)

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.026	0.830
ethylbenzene	3.4	2.823	0.830
styrene	1.9	1.577	0.830
xylene	5.9	4.898	0.830
Semi-Volatile Organic Compounds			
PM_{10}	——	22.33	——
naphthalene	84.3	1.883×10^{-3}	2.233×10^{-5}
acenaphthene	140	3.126×10^{-3}	2.233×10^{-5}
fluorene	100	2.233×10^{-3}	2.233×10^{-5}
pentachlorophenol	180	4.020×10^{-3}	2.233×10^{-5}
phenanthrene	250	5.585×10^{-3}	2.233×10^{-5}
anthracene	230	5.136×10^{-3}	2.233×10^{-5}
carbazole	60	1.340×10^{-3}	2.233×10^{-5}
fluoranthene	430	9.602×10^{-3}	2.233×10^{-5}
pyrene	390	8.709×10^{-3}	2.233×10^{-5}
benzo(a)anthracene	72	1.608×10^{-3}	2.233×10^{-5}
chrysene	110	2.456×10^{-3}	2.233×10^{-5}
benzo(b)fluoranthene	52.6	1.175×10^{-3}	2.233×10^{-5}
benzo(k)fluoranthene	48.2	1.076×10^{-3}	2.233×10^{-5}
benzo(a)pyrene	43.5	9.714×10^{-4}	2.233×10^{-5}

5. Excavate/Unswayed Thermal Treatment (Excavation only, continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.002	6.962×10^{-2}
ethylbenzene	3.4	0.237	6.962×10^{-2}
styrene	1.9	0.132	6.962×10^{-2}
xylene	5.9	0.411	6.962×10^{-2}
Semi-Volatile Organic Compounds			
PM_{10}	———	1.872	———
naphthalene	84.3	1.578×10^{-4}	1.872×10^{-6}
acenaphthene	140	2.621×10^{-4}	1.872×10^{-6}
fluorene	100	1.872×10^{-4}	1.872×10^{-6}
pentachlorophenol	180	3.370×10^{-4}	1.872×10^{-6}
phenanthrene	250	4.681×10^{-4}	1.872×10^{-6}
anthracene	230	4.307×10^{-4}	1.872×10^{-6}
carbazole	60	1.123×10^{-4}	1.872×10^{-6}
fluoranthene	430	8.051×10^{-4}	1.872×10^{-6}
pyrene	390	7.302×10^{-4}	1.872×10^{-6}
benzo(a)anthracene	72	1.348×10^{-4}	1.872×10^{-6}
chrysene	110	2.060×10^{-4}	1.872×10^{-6}
benzo(b)fluoranthene	52.6	9.849×10^{-5}	1.872×10^{-6}
benzo(k)fluoranthene	48.2	9.025×10^{-5}	1.872×10^{-6}
benzo(a)pyrene	43.5	8.145×10^{-5}	1.872×10^{-6}

5. Excavate/Unswayed Thermal Treatment (Thermal desorber only)

Assumptions:

a. Due to excavation and material handling activities, all of the VOCs (except naphthalene) will volatilize from the soil in the two years.
b. Contaminant particulate emissions were estimated for excavation of soil, adding the soil to a truck, trucking the soil on the unpaved contaminated site soil (7,500 trips, 800 feet average roundtrip per truck) and dumping the soil at the thermal desorption unit.
c. Emissions from residual material - use normalized annual average contaminant concentrations from the "No Action" scenario.

d. The thermal desorber is either a rotary dryer or an asphalt aggregate dryer.
e. Efficiency of the thermal desorber is 99.5% on semi-volatiles and PAHs.
f. The air emission control system is 99% efficient.
g. The thermal desorber is located 100 m away from the site fenceline.
h. The maximum pollutant ambient air concentration is located 82 meters away from the fenceline.
i. The thermal desorber will operate for 2 years, 350 days a year, 24 hours a day.
j. The feedrate to the unit will be 8,387 Kg/hr.
k. Stack parameters of the thermal desorber are the following:
   stack height = 10 m
   stack diameter = 0.4 m
   exit gas velocity = 15 m/s
   exit gas temperature = 393 K

5. Ambient Air Concentrations Due to Thermal Desorber Only

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Semi-Volatile Organic Compounds			
naphthalene	84.3	1.88×10^{-2}	2.244×10^{-4}
acenaphthene	140	3.16×10^{-2}	2.244×10^{-4}
fluorene	100	2.25×10^{-2}	2.244×10^{-4}
pentachlorophenol	180	4.04×10^{-2}	2.244×10^{-4}
phenanthrene	250	5.79×10^{-2}	2.244×10^{-4}
anthracene	230	5.16×10^{-2}	2.244×10^{-4}
carbazole	60	1.35×10^{-2}	2.244×10^{-4}
fluoranthene	430	9.65×10^{-2}	2.244×10^{-4}
pyrene	390	8.75×10^{-2}	2.244×10^{-4}
benzo(a)anthracene	72	1.62×10^{-2}	2.244×10^{-4}
chrysene	110	2.47×10^{-2}	2.244×10^{-4}
benzo(b)flouranthene	52.6	1.18×10^{-2}	2.244×10^{-4}
benzo(k)flouranthene	48.2	1.08×10^{-3}	2.244×10^{-4}
benzo(a)pyrene	43.5	9.78×10^{-3}	2.244×10^{-4}

5. Ambient Air Concentrations Due to Thermal Desorber Only (continued)

82 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Semi-Volatile Organic Compounds			
naphthalene	84.3	2.08×10^{-2}	2.477×10^{-4}
acenaphthene	140	3.47×10^{-2}	2.477×10^{-4}
fluorene	100	2.48×10^{-2}	2.477×10^{-4}
pentachlorophenol	180	4.46×10^{-2}	2.477×10^{-4}
phenanthrene	250	6.19×10^{-2}	2.477×10^{-4}
anthracene	230	5.70×10^{-2}	2.477×10^{-4}
carbazole	60	1.49×10^{-2}	2.477×10^{-4}
fluoranthene	430	1.06×10^{-1}	2.477×10^{-4}
pyrene	390	9.66×10^{-2}	2.477×10^{-4}
benzo(a)anthracene	72	1.78×10^{-2}	2.477×10^{-4}
chrysene	110	2.72×10^{-2}	2.477×10^{-4}
benzo(b)flouranthene	52.6	1.30×10^{-2}	2.477×10^{-4}
benzo(k)flouranthene	48.2	1.19×10^{-2}	2.477×10^{-4}
benzo(a)pyrene	43.5	1.08×10^{-2}	2.477×10^{-4}

Remediation Scenarios

6. Excavate/Unswayed Incineration (Excavation only)

Assumptions:

a. Due to excavation and material handling activities, all of the VOCs (except naphthalene) will volatilize from the soil in the two years.
b. Contaminant particulate emissions were estimated for excavation of soil, adding the soil to a truck, trucking the soil on the unpaved contaminated site soil (7,500 trips, 800 feet average roundtrip per truck) and dumping the soil at the incinerator.
c. Emissions from residual material - use normalized annual average contaminant concentrations from the "No Action" scenario.

6. Excavate/Unswayed Incineration (Excavation only)

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.026	0.830
ethylbenzene	3.4	2.823	0.830
styrene	1.9	1.577	0.830
xylene	5.9	4.898	0.830
Semi-Volatile Organic Compounds			
PM_{10}	——	22.33	——
naphthalene	84.3	1.883×10^{-3}	2.233×10^{-5}
acenaphthene	140	3.126×10^{-3}	2.233×10^{-5}
fluorene	100	2.233×10^{-3}	2.233×10^{-5}
pentachlorophenol	180	4.020×10^{-3}	2.233×10^{-5}
phenanthrene	250	5.585×10^{-3}	2.233×10^{-5}
anthracene	230	5.136×10^{-3}	2.233×10^{-5}
carbazole	60	1.340×10^{-3}	2.233×10^{-5}
fluoranthene	430	9.602×10^{-3}	2.233×10^{-5}
pyrene	390	8.709×10^{-3}	2.233×10^{-5}
benzo(a)anthracene	72	1.608×10^{-3}	2.233×10^{-5}
chrysene	110	2.456×10^{-3}	2.233×10^{-5}
benzo(b)fluoranthene	52.6	1.175×10^{-3}	2.233×10^{-5}
benzo(k)fluoranthene	48.2	1.076×10^{-3}	2.233×10^{-5}
benzo(a)pyrene	43.5	9.714×10^{-4}	2.233×10^{-5}

6. Excavate/Unswayed Incineration (Excavation only, continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Volatile Organic Compounds			
benzene	0.031	0.002	6.962×10^{-2}
ethylbenzene	3.4	0.237	6.962×10^{-2}
styrene	1.9	0.132	6.962×10^{-2}
xylene	5.9	0.411	6.962×10^{-2}
Semi-Volatile Organic Compounds			
PM_{10}	———	1.872	———
naphthalene	84.3	1.578×10^{-4}	1.872×10^{-6}
acenaphthene	140	2.621×10^{-4}	1.872×10^{-6}
fluorene	100	1.872×10^{-4}	1.872×10^{-6}
pentachlorophenol	180	3.370×10^{-4}	1.872×10^{-6}
phenanthrene	250	4.681×10^{-4}	1.872×10^{-6}
anthracene	230	4.307×10^{-4}	1.872×10^{-6}
carbazole	60	1.123×10^{-4}	1.872×10^{-6}
fluoranthene	430	8.051×10^{-4}	1.872×10^{-6}
pyrene	390	7.302×10^{-4}	1.872×10^{-6}
benzo(a)anthracene	72	1.348×10^{-4}	1.872×10^{-6}
chrysene	110	2.060×10^{-4}	1.872×10^{-6}
benzo(b)fluoranthene	52.6	9.849×10^{-5}	1.872×10^{-6}
benzo(k)fluoranthene	48.2	9.025×10^{-5}	1.872×10^{-6}
benzo(a)pyrene	43.5	8.145×10^{-5}	1.872×10^{-6}

7. Excavate/Unswayed Bio-Remediation (Composting)

Assumptions:

a. Volatilization data for the semi-volatile organic compounds were taken from the journal article entitled *Bench-Scale Evaluation of Alternative Biological Treatment Processes for the Remediation of Pentachlorophenol- and Creosote-Contaminated Material: Solid-Phase Bioremediation* from Environmental Science Technology, Volume 25, No. 6, 1991.

b. The above study was performed for a period of 12 weeks. The volatilization results from the study were assumed to be continuous for an entire year.

c. Data for pyrene were not available, and data for benzo(b)flouranthene and benzo(k)flouranthene were combined.

d. Since volatilization was on the order of 0.01% of the contaminants in the soil, there was no adjustment made to the possible degradation of contaminants in the soil during the remedy.

e. Bioremediation is assumed to take place on the 2.9 acres of the Land Treatment Area of the site.

f. Remediation will occur in three batches, five years for each batch, for a total of 15 years.

g. Volatilization is assumed to be constant for each year.

7. Ambient Air Concentrations Due to Bio-remediation Only

fenceline

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Semi-Volatile Organic Compounds			
naphthalene	84.3	1.26×10^{-1}	1.495×10^{-3}
acenaphthene	140	4.11×10^{-2}	2.936×10^{-4}
fluorene	100	1.89×10^{-1}	1.890×10^{-3}
pentachlorophenol	180	2.84×10^{-2}	1.578×10^{-4}
phenanthrene	250	3.94×10^{-2}	1.576×10^{-4}
anthracene	230	5.91×10^{-2}	2.570×10^{-4}
carbazole	60	2.32×10^{-2}	3.867×10^{-4}
fluoranthene	430	3.86×10^{-3}	8.977×10^{-6}
pyrene	390	—	—
benzo(a)anthracene	72	6.60×10^{-2}	9.167×10^{-4}
chrysene	110	1.21×10^{-2}	1.100×10^{-4}
benzo(b,k)fluoranthene	52.6	8.23×10^{-4}	1.565×10^{-5}
benzo(a)pyrene	43.5	1.39×10^{-2}	3.195×10^{-4}

7. Ambient Air Concentrations Due to Bio-remediation Only (continued)

50 m away

Compound	Max. Conc. (ppm)	Annual Average Conc. ($\mu g/m^3$)	Normalized Annual Avg. Conc. [($\mu g/m^3$)/ppm]
Semi-Volatile Organic Compounds			
naphthalene	84.3	7.15×10^{-3}	8.482×10^{-5}
acenaphthene	140	2.34×10^{-3}	1.671×10^{-5}
fluorene	100	1.07×10^{-2}	1.070×10^{-4}
pentachlorophenol	180	1.61×10^{-3}	8.944×10^{-6}
phenanthrene	250	2.24×10^{-3}	8.960×10^{-6}
anthracene	230	3.36×10^{-3}	1.461×10^{-5}
carbazole	60	1.32×10^{-3}	2.200×10^{-5}
fluoranthene	430	2.20×10^{-4}	5.116×10^{-7}
pyrene	390	—	—
benzo(a)anthracene	72	3.75×10^{-3}	5.208×10^{-5}
chrysene	110	6.87×10^{-4}	6.245×10^{-6}
benzo(b,k)fluoranthene	52.6	4.68×10^{-5}	8.897×10^{-5}
benzo(a)pyrene	43.5	7.93×10^{-4}	1.823×10^{-5}

8. Excavate/Unswayed Slurry-Phase Biological Reactor

Assumptions:

a. Volatilization data for the semi-volatile organic compounds were taken from the journal article entitled *Bench-Scale Evaluation of Alternative Biological Treatment Processes for the Remediation of Pentachlorophenol- and Creosote-Contaminated Material: Slurry-Phase Bioremediation* in Environmental Science Technology, Volume 25, No. 6, 1991.

b. The above study was performed for a period of 30 days as a batch process. The process assumed for the Southern Maryland Woodtreatment Plant is a steady-state process outlined in *Pilot-Scale Demonstration of a Slurry-Phase Biological Reactor for Creosote-Contaminated Soil*: EPA/540/A5-91/009. The process assumes that a 290,000 gallon reactor will be used and the retention time in the reactor will be 14 days. Therefore, the volatilization rates acquired from *Bench-Scale...* were modified to account for a steady-state process.

c. Volatilization data for pentachlorophenol and benzo(a)anthracene were reported as undetected, and data for benzo(b)flouranthene and benzo(k)flouranthene were combined.

d. The bio-reactor was assumed to be 10 feet deep and 19 meters in length and width. It was modeled as an area source using the air dispersion model ISCLT2 and ten years of meteorological data from the nearby Patuxent Naval Base. The fenceline is assumed to be 100 meters away from the reactor.

e. Remediation will occur continuously for 15 years. Volatilization is assumed to be constant for each year. Air emission controls are not present.

8. Ambient Air Concentrations Due to Bio-Slurry Remediation Only

Compound	Maximum Conc. (ppm)	Annual Average Conc. @50m ($\mu g/m^3$)	Annual Average Conc. @100m ($\mu g/m^3$)
Semi-Volatile Organic Compounds			
naphthalene	84.3	1.45×10^{-1}	5.24×10^{-2}
acenaphthene	140	7.75×10^{-2}	2.80×10^{-2}
fluorene	100	1.76×10^{-3}	6.34×10^{-4}
pentachlorophenol	180	—	—
phenanthrene	250	2.96×10^{-3}	1.07×10^{-3}
anthracene	230	8.68×10^{-4}	3.13×10^{-4}
carbazole	60	5.04×10^{-3}	1.82×10^{-3}
fluoranthene	430	7.38×10^{-6}	2.66×10^{-6}
pyrene	390	1.11×10^{-3}	4.01×10^{-4}
benzo(a)anthracene	72	—	—
chrysene	110	1.05×10^{-3}	3.80×10^{-4}
benzo(b,k)fluoranthene	52.6	2.25×10^{-3}	8.12×10^{-4}
benzo(a)pyrene	43.5	3.44×10^{-5}	1.24×10^{-5}

APPENDIX 2: ESTIMATES OF CONTAMINANT CONCENTRATIONS IN GROUNDWATER AFTER REMEDIATION: SOUTHERN MARYLAND WOOD TREATMENT SITE

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REGION 3
HAZARDOUS WASTE MANAGEMENT DIVISION

November 10, 1994

Southern Maryland Wood Treatment Site

Resulting ground water concentrations from starting unsaturated zone soil concentrations

	Remedial alternatives: 6&7 Subsurface				
	Ct (mg/Kg)	Kd (L/mg)	Cw (unsat) (ug/L)	DAF	Cw (gw) (ug/L)
Carcinogenic PAH:					
Benzo[a]pyrene	0.5965	1373.90	0.434	10.25	0.042
Benzo[b]fluoranthene	0.6916	3436.30	0.201	24.45	0.008
Benzo[k]fluoranthene	0.7167	6398.70	0.112	45.249	0.002
Benz[a]anthracene	1.4044	535.40	2.623	5.107	0.514
Carbazole	4.5882	4.90	936.367	3.845	243.528
Chrysene	2.0027	376.78	5.315	4.392	1.210
Total CPAH:	10.0000				
Noncarcinogenic PAH:					
Acenaphthene	6.3850	7.70	829.215	3.845	215.661
Anthracene	17.5558	26.10	672.637	3.845	174.938
Fluoranthene	8.9181	73.50	121.335	3.845	31.557
Fluorene	5.9304	14.00	423.603	3.845	110.170
Naphthalene	6.9008	1.80	3833.792	3.845	997.085
Phenanthrene	15.1972	26.70	569.184	3.845	148.032
Pyrene	5.9345	70.20	84.537	3.845	21.986
Total PAH:	76.8219				
Pentachlorophenol	0.7581	79.50	9.535	3.845	2.480
Volatile aromatics:					
Benzene	0.0004	0.13	3.192	3.845	0.830
Ethylbenzene	0.0455	1.30	35.006	3.845	9.104
Styrene	0.0254	1.40	18.165	3.845	4.724
Xylene	0.0790	0.40	197.424	3.845	51.346

Assumption: Ct is equivalent to Cs in subsurface soils

File: ADJCW1.WK1

Southern Maryland Wood Treatment Site

Resulting ground water concentrations from starting unsaturated zone soil concentrations

Remedial alternatives: 8a
5 years
Subsurface

Contaminant	Ct (mg/Kg)	Kd (L/mg)	Cw (unsat) (ug/L)	DAF	Cw (g.w.) (ug/L)
Carcinogenic PAH:					
Benzo[a]pyrene	5.6849	1373.90	4.138	10.25	0.404
Benzo[b]fluoranthene	6.5917	3436.30	1.918	24.45	0.078
Benzo[k]fluoranthene	6.8305	6398.70	1.067	45.249	0.024
Benz[a]anthracene	13.3852	535.40	25.000	5.107	4.895
Carbazole	2.6928	4.90	549.548	3.845	142.925
Chrysene	19.0881	376.78	50.661	4.392	11.535
Total CPAH:	54.2732				
Noncarcinogenic PAH:					
Acenaphthene	0.0002	7.70	0.028	3.845	0.007
Anthracene	5.3341	26.10	204.373	3.845	53.153
Fluoranthene	84.9997	73.50	1156.458	3.845	300.769
Fluorene	0.0574	14.00	4.103	3.845	1.067
Naphthalene	0.0000	1.80	0.026	3.845	0.007
Phenanthrene	0.0459	26.70	1.718	3.845	0.447
Pyrene	56.5625	70.20	805.733	3.845	209.553
Total PAH:	201.2731				
Pentachlorophenol	0.0465	79.50	0.584	3.845	0.152
Volatile aromatics:					
Benzene	0.0000	0.13	0.000	3.845	0.000
Ethylbenzene	0.0000	1.30	0.000	3.845	0.000
Styrene	0.0000	1.40	0.000	3.845	0.000
Xylene	0.0000	0.40	0.000	3.845	0.000

Assumption: Ct is assumed to be equivalent to Cs in subsurface

File: ADJCW2.WK1

Southern Maryland Wood

Resulting ground water concentrations from starting unsaturated zone soil concentrations

Remedial alternatives: 86
10 years

Contaminant	Ct (mg/Kg)	Kd (L/mg)	Cw (unsat) (ug/L)	DAF	Cw (g.w. (ug/L)
Carcinogenic PAH:					
Benzo[a]pyrene	0.7252	1373.90	0.5279	10.250	0.0515
Benzo[b]fluoranthene	0.8409	3436.30	0.2447	24.450	0.0100
Benzo[k]fluoranthene	0.8714	6398.70	0.1362	45.249	0.0030
Benz[a]anthracene	1.7076	535.40	3.1893	5.107	0.6245
Carbazole	0.0212	4.90	4.3169	3.845	1.1227
Chrysene	2.4351	376.78	6.4629	4.392	1.4715
Total CPAH:	6.6013				
Noncarcinogenic PAH:					
Acenaphthene	0.0000	7.70	0.0000	3.845	0.0000
Anthracene	0.0217	26.10	0.8311	3.845	0.2162
Fluoranthene	10.8434	73.50	147.5298	3.845	38.3693
Fluorene	0.0000	14.00	0.0005	3.845	0.0001
Naphthalene	0.0000	1.80	0.0000	3.845	0.0000
Phenanthrene	0.0000	26.70	0.0001	3.845	0.0000
Pyrene	7.2157	70.20	102.7877	3.845	26.7328
Total PAH:	24.6821				
Pentachlorophenol	0.0000	79.50	0.0005	3.845	0.0001
Volatile aromatics:					
Benzene	0.0000	0.13	0.0000	3.845	0.0000
Ethylbenzene	0.0000	1.30	0.0000	3.845	0.0000
Styrene	0.0000	1.40	0.0000	3.845	0.0000
Xylene	0.0000	0.40	0.0000	3.845	0.0000

Assumption: Ct assumed to be equivalent to Cs in subsurface soils

File: ADJCA3.WK1

Southern Maryland Wood

Resulting ground water concentrations from starting unsaturated zone soil concentrations

Remedial alternative:
9 years

Contaminant	Ct (mg/Kg)	Kd (L/kg)	Cw (unsat) (ug/L)	DAF	Cw (g.w. (ug/L)
Carcinogenic PAH:					
Benzo[a]pyrene	2.2281	1373.90	1.622	10.250	0.1582
Benzo[b]fluoranthene	2.5836	3436.30	0.752	24.450	0.0308
Benzo[k]fluoranthene	2.6772	6398.70	0.418	45.249	0.0092
Benz[a]anthracene	5.2462	535.40	9.799	5.107	1.9187
Carbazole	17.1398	4.90	3497.913	3.845	909.7302
Chrysene	7.4814	376.78	19.856	4.392	4.5210
Total CPAH:	37.3562				
Noncarcinogenic PAH:					
Acenaphthene	23.8518	7.70	3097.636	3.845	805.6270
Anthracene	65.5820	26.10	2512.719	3.845	653.5030
Fluoranthene	33.3148	73.50	453.263	3.845	117.8836
Fluorene	22.1539	14.00	1582.422	3.845	411.5532
Naphthalene	25.7789	1.80	14321.602	3.845	3724.7340
Phenanthrene	56.7711	26.70	2126.258	3.845	552.9930
Pyrene	22.1691	70.20	315.799	3.845	82.1325
Total PAH:	286.9778				
Pentachlorophenol	2.8318	79.50	35.620	3.845	9.2641
Volatile aromatics:					
Benzene	0.0000	0.13	0.000	3.845	0.0000
Ethylbenzene	0.0000	1.30	0.000	3.845	0.0000
Styrene	0.0000	1.40	0.000	3.845	0.0000
Xylene	0.0000	0.40	0.000	3.845	0.0000

Assumption: Ct is equivalent to Cs in subsurface

File: ADJCW4.WK1